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ABSTRACT

This compendium is a tool for bringing waste management education into classrooms. Curriculum materials gathered from across the country were reviewed by California's top environmental educators, both for correlation with the state's educational frameworks and for accuracy and completeness of waste management information. Materials that cover household hazardous wastes, recycling, and solid wastes were evaluated for appropriateness at four grade levels: K-3, 4-6, 7-9, and 10-12. Curricula are arranged in each grade level by rating. Both descriptive and evaluative information is included about each of the 44 materials that scored at or above the required B- level. Two sample pages are featured from each selected curriculum. Each evaluation includes a description of the curriculum, ordering information, a "report card," and comments from evaluators regarding the content and other areas evaluated. A key to the evaluation and the evaluation tool are presented. Significant findings are summarized in the areas of trends, content, grade level coverage, pedagogy, multilingual materials, and teacher usability. Appendices provide a description of the California Department of Education's Environmental Education Curriculum and Compendium Project (of which this is one component), conceptual matrices for environmental education, unifying concepts of environmental education, a conceptual matrix for integrated waste management, conceptual matrix framework correlations, the evaluation tool, and a listing of other curricula evaluated. (LZ)

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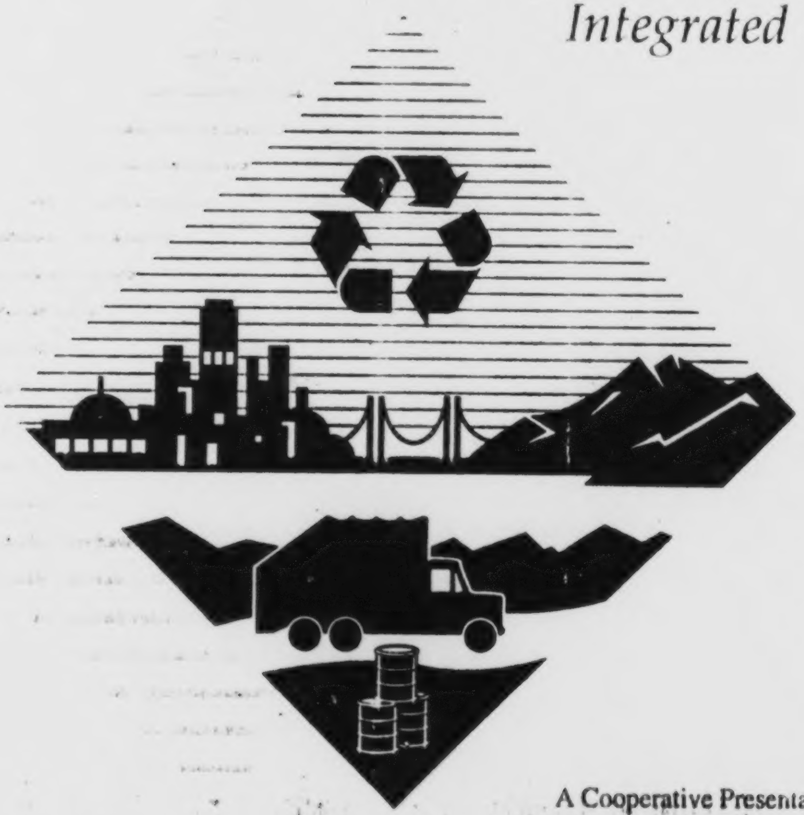
Environmental Education

Compendium for Integrated Waste Management



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A Cooperative Presentation by:
The California Department of Education,
The California Integrated Waste Management Board
The California Department of Toxic Substance Control
June 1993

Environmental Education

. . . .

Compendium for Integrated Waste Management

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The California Department of Toxic Substances Control
June 1993

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To The Educator

Dear Educator,

It is our pleasure to present to you the Compendium for Integrated Waste Management, a cooperative presentation by the Department of Education, Integrated Waste Management Board, and Department of Toxic Substances Control.

We recognize that you, as educators, face an enormous challenge in incorporating environmental education into your classrooms. While there is a great deal of material available, in environmental education and specifically in hazardous and solid waste management, these materials often are not easily accessible or fail to meet the high standards established by California education frameworks.

Modern educational standards stress that students actively construct their own knowledge of environmental issues through research, discussion, and application. This understanding gives students the tools with which to take diverse perspectives, apply their own knowledge, and develop strategies for responsible action.

The materials in this compendium were evaluated not only to meet the educational standards of the frameworks, but to help you locate curricula that are up-to-date and accurate in portraying the waste management challenges and dilemmas that face California and the world in the years ahead. Students need to understand the implications of their personal resource use and waste management practices in order to make informed decisions. You, as teachers, play a vital role in this process, by making quality waste management instruction a part of your classroom.

This compendium is one of a series providing information on quality environmental education instructional materials. We hope that the Compendium for Integrated Waste Management provides you with resources to instruct and empower your students to actively participate in the waste management decisions of today and tomorrow.

We offer this compendium to you and to the children of California.

Sincerely,

Bill Andrews
Bill Andrews
Education Programs Consultant
Science and Environmental Education Unit
California Department of Education

Kathy Neal
Chair
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Member, California Integrated Waste
Management Board

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About This Compendium

Introduction

This compendium is an easy-to-use guide to waste management education materials. Environmental education is appropriate in any discipline, and many educators integrate environmental concepts in their lesson plans. However, finding suitable materials can be a time consuming and complicated task. This compendium of curriculum materials has been developed to assist educators in locating quality materials that are appropriate for use in their classroom.

Materials

An extensive nationwide search was conducted to locate and obtain teaching materials that focused on solid and hazardous waste. These materials were then evaluated by California environmental educators using an evaluation tool developed by the California Department of Education, in collaboration with the California Integrated Waste Management Board and the California Department of Toxic Substances Control. The goal was to identify those curricula which align with the California education frameworks, and are accurate and comprehensive in the content areas of solid and hazardous waste management.

Curricula were evaluated for appropriateness at four grade levels: K-3, 4-6, 7-9, and 10-12. Each curriculum was evaluated by a team of educators who have experience at its target grade level. Multi-level curricula were evaluated at each grade level that they encompassed, resulting in some curricula being evaluated by up to four different evaluation teams.

Only those materials which received an overall grade of B- or better are included in the main part of the compendium. An exception was made at the K-3 grade level, where only two curricula achieved a B- average. Materials averaging a C+ were also included at this grade level. Curricula with lower average scores are listed in the appendices.

For ease of use, the main body of the compendium has been divided into the four grade-level sections. Curricula are arranged within each section by rating; those with the highest ratings are listed first. Some curricula may appear in more than one grade level section. Within each grade-level section the materials are delineated by subject emphasis: solid waste, hazardous waste, and a combination of solid and hazardous waste. Curricula covering both topic areas received two overall grades.

Evaluations

On the following pages, you will find both descriptive and evaluative information about each piece of material that scored at or above the required B- level. Two sample pages are featured from each selected curriculum. Due to the length of some lessons, only a portion of the sample lesson was reproduced. Each evaluation includes a description of the curriculum, paraphrased from its introduction; ordering information; a "report card"; and comments from evaluators regarding the content and other areas evaluated (see "Key to the Evaluations," page 4). Although the comments were edited for clarity, they were all gleaned from the teachers' own thoughts as written on the evaluations.

Appendices

In the appendices, you will find a description of the California Department of Education's Environmental Education Curriculum and Compendium Project (of which this is one component), the Unifying Concepts for Environmental Education, the Conceptual Matrix for Integrated Waste Management Education (with correlations to the California state frameworks), the evaluation tool, and a listing of other curricula that were evaluated, but not rated in the compendium.

Reviewers

The curricula were evaluated by teams of outstanding environmental educators from throughout California. These educators were chosen on the basis of their environmental education experience and expertise, as well as background in waste management issues and knowledge of the frameworks. This distinguished group of evaluators provided an important service to all educators concerned with environmental education and hazardous and solid waste management.

Funding

This project was funded through a cooperative agreement between the California Integrated Waste Management Board and the California Department of Toxic Substances Control, and with funding from the Environmental Education Grant Program administered by the California Department of Education.

Conclusion

While this compendium was developed to show the strengths and weaknesses in existing waste management curricula, it was also intended to serve as a guide for curriculum developers in producing high quality materials in the future. This project identified several noteworthy curricula; however, even these materials would benefit from refinement. Many of these materials were developed for use in other geographic areas, and would require some degree of adaptation for use in California. Materials need to be developed or translated into languages that reflect the cultural diversity of California. In addition, curricula need to be developed at the K-3 and 10-12 grade levels (see "Significant Findings," page 3). Lastly this compendium is intended as a tool for educators interesting in integrating waste management education into curricula at all levels, to empower students to make responsible choices regarding the wise use of our valuable resources.

Significant Findings

One purpose of this review was to identify strengths and areas needing improvement in existing materials to provide direction for the development of future waste management curricula. Of the 127 curricula originally evaluated, only 44 scored high enough for inclusion. Findings related to the curriculum strengths and weaknesses are summarized below.

Trends

Approximately half of the curricula were developed by government agencies; the remainder by private advocacy groups. Many materials had a relatively short shelf-life; although they included sufficient breadth of coverage, they relied on current statistical information for their lessons. Few materials indicated field testing prior to publishing. Although most curricula credited original sources, similar lessons appeared in many curricula; few materials displayed original research or ideas.

While older materials tended to focus exclusively on collection of recyclable materials and litter control, more recently published materials showed a trend towards a more comprehensive, integrated approach to waste management concepts.

Content

Background information for teachers was often lacking in either quality or quantity. Much of the background information given was in the form of "factoids," statistical snapshots that are abstract or subject to constant fluctuation.

Hazardous waste generated and disposed of by business and industry was not adequately addressed; rather, the emphasis was on household hazardous waste. Disposal methods were emphasized over reduction in the use of hazardous products. Waste prevention and waste reduction were often not addressed thoroughly or prominently. "Closing the loop," or completing the recycling process through the purchase and use of recycled-content products, did not receive much attention.

Grade Level Coverage

The majority of materials obtained in the nationwide search were written for grades 4-6. The greatest percentage of high-scoring materials was found at this level. Few materials met the minimum inclusion criteria in either the K-3 or the 10-12 grade levels, with 7-9 materials making a somewhat better showing. Hazardous waste educational materials are scarce at the K-3 grade level.

Pedagogy

Many materials were identified as lacking in authentic assessment devices, hands-on activities, or age-appropriate materials. Few curricula reflect advances in cognitive science, such as application of constructivist learning theory (where students construct knowledge). Many curricula used experiments and explorations that were described as too scripted or "cookbook" in their methodology.

Multilingual Materials

Very few materials are available in languages other than English. To reflect and respect the diversity of California's citizens, environmental education materials need to be provided in the primary languages of students and families participating in these programs.

Teacher Usability

Other curriculum weaknesses included page layout and presentation, page numbering or indexing, and difficulty in reproducing overheads and student worksheets. Evaluators expressed a preference for materials that were physically divided (either in tabbed sections or separate volumes) by grade level.

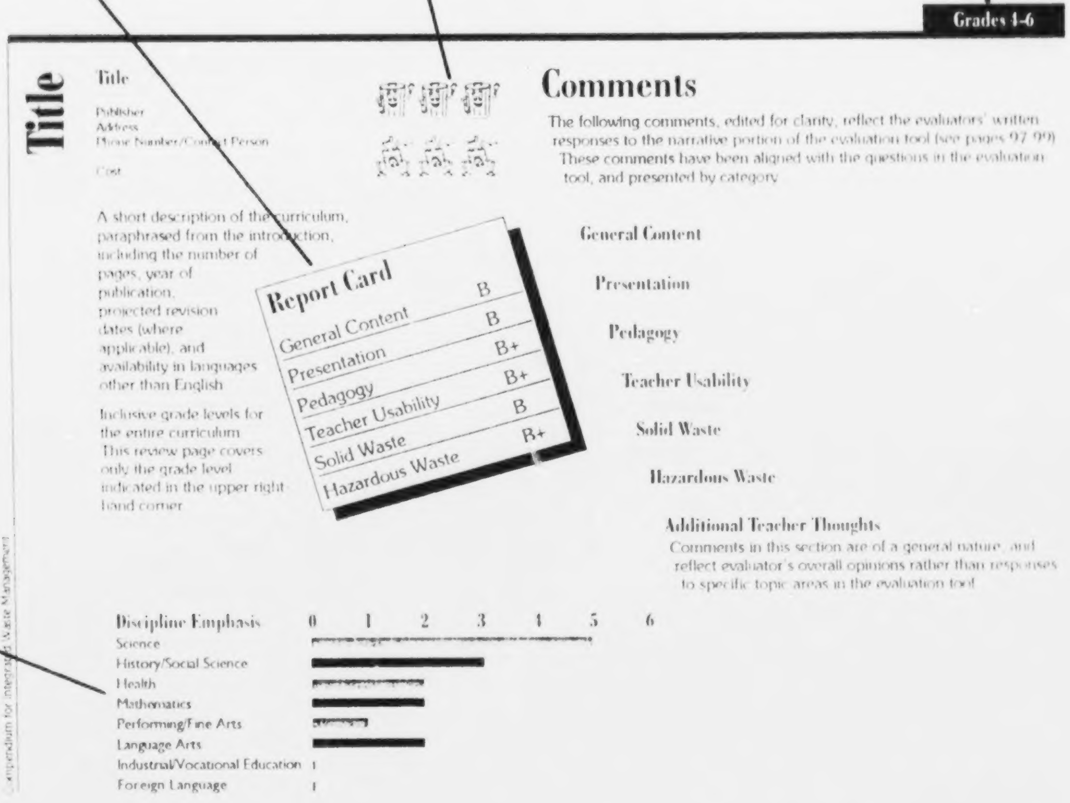
Key to the Evaluations

The "Report Card" indicates the scores for each specific evaluation area (see "Evaluation Tool," pages 97-99). The Evaluation Tool was used to determine the letter grades.

Each piece of material received an overall rating combining the component letter grades listed on the "Report Card." Materials evaluated for Solid Waste are indicated by happy, empty trash cans; materials evaluated for Hazardous Waste are indicated by empty, cartwheeling waste drums. Curricula were rated on a scale of zero to five, in increments of one-half.

This indicates the grade level of this evaluation. Multi-level curricula were evaluated at all applicable grade levels, and may appear elsewhere in the compendium.

On the facing page are two sample pages from the curricula. As many lessons are more than two pages in length, the sample pages may not include an entire lesson.



Grades 4-6

Title

Title

Publisher
Address
Phone Number/Contact Person

Cost

A short description of the curriculum, paraphrased from the introduction, including the number of pages, year of publication, projected revision dates (where applicable), and availability in languages other than English

Inclusive grade levels for the entire curriculum. This review page covers only the grade level indicated in the upper right hand corner

Report Card	
General Content	B
Presentation	B
Pedagogy	B+
Teacher Usability	B+
Solid Waste	B
Hazardous Waste	B+

Comments

The following comments, edited for clarity, reflect the evaluators' written responses to the narrative portion of the evaluation tool (see pages 97-99). These comments have been aligned with the questions in the evaluation tool, and presented by category

General Content

Presentation

Pedagogy

Teacher Usability

Solid Waste

Hazardous Waste

Additional Teacher Thoughts

Comments in this section are of a general nature, and reflect evaluator's overall opinions rather than responses to specific topic areas in the evaluation tool

Evaluators were asked to estimate the emphasis given to each discipline in the curriculum. Scores were averaged and placed on a scale of zero to six, with zero being "no" emphasis, two indicating "some" emphasis, four showing "a lot" of emphasis, and a score of six being given to materials with a "major emphasis" in that subject area.

Waste Is a Terrible Thing To Waste

Waste Is a Terrible Thing To Waste

Exegetics Interpretative and
Educational Services
P.O. Box 191895
Sacramento, CA 95819-7895
(916) 381-7795

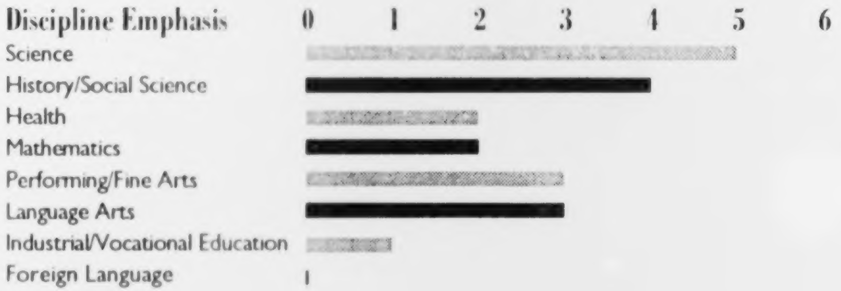
$35 plus tax

A collection of classroom activities for grades K-6, ranging from simple worksheets to difficult socio-dramas. This collection was written at the request of the Sacramento County, California, Solid Waste Management Division. 118 pages, 1991.

Grades K-6

Report Card

General Content	B
Presentation	B-
Pedagogy	B-
Teacher Usability	B
Solid Waste	C+



Comments

General Content

Higher level thinking skills would be excellent for G.A.T.E. (Gifted And Talented Education). "These are great activities and were balanced throughout the curriculum; however, they are missing a common storyline."

Presentation

Good charts, great format, excellent layout. Grade-appropriate; however, there are few activities for grades K-1 and no LEP (Limited English Proficient) component.

Pedagogy

Action-oriented, active learning that empowers students and encourages responsible action. Wonderful activities utilizing a variety of instructional strategies.

Teacher Usability

Well-organized, but needs index of covered concepts. Great background information. Simplicity of directions makes it "teacher-friendly." Very good resource section and glossary.

Solid Waste

No discussion of composting or alternatives to landfills. Some things not covered in K-3 lessons are covered in 4-6.

Additional Teacher Thoughts

"The curriculum effectively covered most of the evaluation areas. It was one of a few that did." Gleaned ideas from many excellent curricula. "Too expensive for an individual."

I Threw It In The Waste Stream

Objectives
Students will: 1) identify major categories of the waste stream; 2) organize their waste into categories; 3) compare their waste generation relative to the overall waste stream; and 4) define which items are recyclable or reusable.

Grades: 1 - 6

Method
In an all-class discussion, students define what they throw away regularly and then fit it into the major categories of the residential waste stream.

Materials
Home Garbage Survey on page 24 (optional)
Paper and pencils
Wastestream Graphs (page 13)

Procedure

Ask students to identify everything they have thrown out in the past week. Write the list on the board.

Distribute ***Home Trash Survey*** or have each student or small group take a piece of paper, turn it sideways and write the following headings across the top:

glass
plastic
tin cans
aluminum
newspaper
paper
food waste
other

Have each student or group place each item from the board into a category.

Discuss with the class:

Now that we have the garbage separated, what do we do with it?

Have students circle items that could be reused.

Approximately what percentage of the total is this?

Have students place a star in front of the items that could be recycled.

Approximately what percentage of the total is this?

Display a copy of the Waste Stream Graph (in the Background section) on the overhead projector or hand out photocopies.

Are the percentages of items about the same for our class and in the waste stream?

Where does all this waste go?

What problems might the students foresee with an area producing this amount of trash?

Extensions

1. Each day for the rest of the week, bring in three pieces of trash and hang them on the bulletin board. Let the class look at them most of the day and then ask for ways they could be re-used or how it could have been avoided in the first place (precycled).

2. Post a map of your county on the wall. Ask students where they think "away" is. *("Away" is the landfill! Locate the local landfills on the map. Could this land be better used in other ways?)*

Home Trash Survey

GLASS	PLASTIC	TIN CANS	ALUMINUM	NEWSPAPER	SCRAP PAPER	FOOD WASTE	OTHER

Wearing gloves, carefully sort through the trash your family has thrown away in the last week.
Place each item in the appropriate column on this chart.
Underline things that were used only once. Circle items that can be re-used. Put a star by items that could be recycled.

Waste Is A Terrible Thing To Waste! — Copyright © 1991,

Closing the Loop

Closing the Loop
Integrated Waste Management
Activities for School and Home

The Institute for
Environmental Education
18554 Haskins Road
Chagrin Falls, OH 44023-1823
(216) 543-7303 Mary Chadbourne

$32 for K-12.
$28 for K-8.
$26 for 9-12.

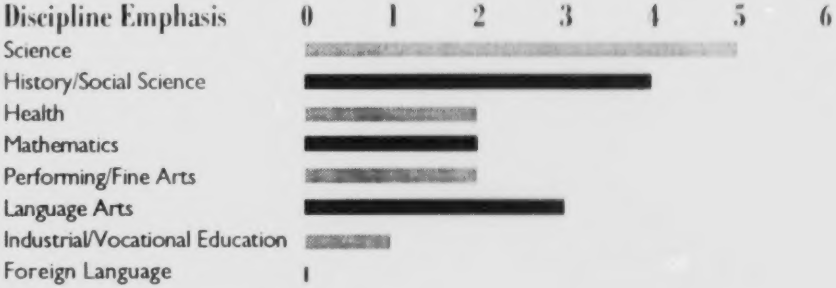
A collection of activities grouped under three thematic sections: Everything Ends Up Somewhere, We Have Options And We Make Choices, and Everything Is Connected. Activities are intended to be hands-on, problem-centered, practical, and adaptable across grade levels and subjects. 1991.

Grades K-12.

Report Card

General Content	B
Presentation	B-
Pedagogy	B-
Teacher Usability	B
Solid Waste	B-
Hazardous Waste	C+

Discipline Emphasis



Comments

General Content

Contains in-depth lessons, with a good breadth of coverage.

Presentation

Poor organization and poor format. Many activities must be adapted for K-1 because some lessons are not age-appropriate.

Pedagogy

Good hands-on activities, with varied approaches to learning. Good cooperative activities that encourage higher-level thinking skills. An excellent emphasis on responsible action which links today's actions with future consequences. Some science activities are "cookbook."

Teacher Usability

The page numbering system is hard to follow. Could be integrated with life, physical, and earth core sciences very easily. Very complete, with a lot of background information. Good natural resource section. "May be very hard for an inexperienced teacher to follow - almost too much information to absorb."

Solid Waste

Addresses source reduction for individuals and schools. Great integration of ideas and methodology in recycling. Very well done.

Additional Teacher Thoughts

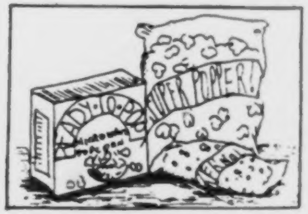
Great for 4-6 plus. K-3 activities should be in a separate section. "Less would be more here, too hard to find, too much to sift through." Too much for most teachers to assimilate. "Would be a great resource for a science person." "Excellent philosophy: lessons, integration, and evaluation."

LET'S HAVE SOME POPCORN . . . BUT *WHICH* POPCORN?

Grades: K-4

Subjects: Consumer literacy, language arts, life skills, mathematics

Format: One to several class periods, depending on the teacher's election of options in the activity



OBJECTIVE: Students will learn (1) how the solid waste problem increases with some purchases they make; (2) that some purchases leave more solid waste than others; (3) that many of those that leave more waste also cost more; (4) the most economical way to buy popcorn; (5) where to look for ingredients to learn what's in the popcorn besides corn; (6) how to work together as part of a team in solving a problem; and, if the teacher wishes to demonstrate it, (7) how to prepare popcorn from scratch.

METHOD: The teacher provide prepopped popcorn, microwave popcorn, and ingredients for popcorn from scratch. The teacher will either prepare the microwave and popcorn-from-scratch in advance or, preferably, have the students make it in class. Children will then measure how many cups are in each kind. The teacher will also provide all of the containers coming with each type of popcorn so that students can examine the waste and recyclables generated and the ingredients in each kind of popcorn.

BACKGROUND: Children grow up to be the consumers. There are many influences on what they buy – family buying practices (e.g., buying fast foods, processed foods, frozen foods, etc.), socio-economic factors, convenience, education, beliefs. If children are to become environmentally wise food shoppers, there are many factors they should consider when they shop: (1) what are the ingredients of the food? Are they healthful? (2) what kind of packaging does the food have? Is it necessary? Recyclable? Reusable? (3) that there are differences in the overall cost of foods -- and those costs include such considerations as the amount of food packaging; whether the packaging is

---

STUDENT ACTIVITY SHEET

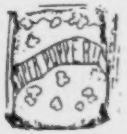
"Popcorn Packages – What Are They Made of & Where Do They Go Next?"

NAME: ______________________

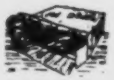
INSTRUCTIONS:

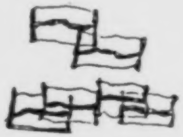
Put a "W" for WASTE under each item that cannot be recycled. Put an "R" under each item that can be recycled.

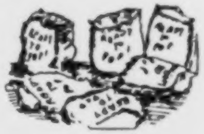
1. PREPOPPED POPCORN:


SUPER POPPER!

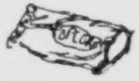
2. MICROWAVE POPCORN:

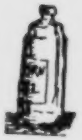


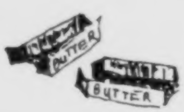


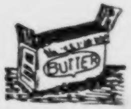


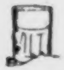
3. POPCORN FROM SCRATCH











RAYS

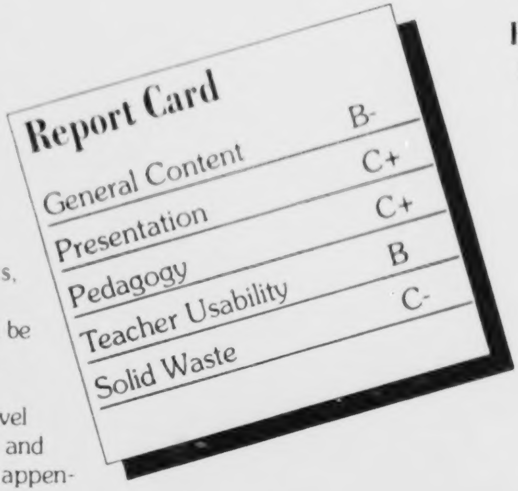
RAYS
"Recycle And You Save"

San Diego County
Division of Solid Waste
5555 Overland Avenue
Mail Stop 0383
San Diego, CA 92123
(619) 974-2648 Carol Gann

$15.

A collection of activities correlated to the California State Frameworks for Science, Social Science, Mathematics, Language Arts, and Health. Designed to be easily integrated into daily teaching plans. Divided into grade level sections of K-2, 3-4, and 5-6. 71 pages, plus appendices, 1991.

Grades K-6.



Report Card

General Content	B-
Presentation	C+
Pedagogy	C+
Teacher Usability	B
Solid Waste	C-

Comments

General Content

Follows old frameworks. Big ideas and unifying concepts missing, with little linkage between lessons. "Good enabling steps for depth of understanding, integrated into scope and sequence, especially for K-1 kids!" Activities are good and incorporate higher-level thinking skills.

Presentation

Printed on one side of recycled paper. Well-written, detailed lessons in an easy format. Some lessons must be adapted to Kindergarten level, but most are developmentally on-target.

Pedagogy

Assessment devices are not comprehensive.

Teacher Usability

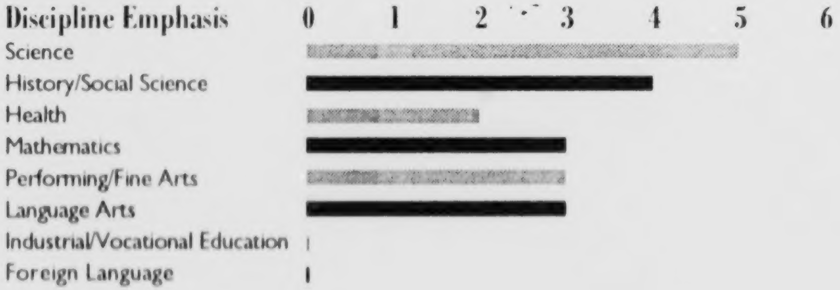
Good blackline masters, but worksheets could be improved. "Teacher- and student-friendly." Some teacher background information is included.

Solid Waste

The waste management hierarchy should be described and taught in the proper order. Breadth of coverage is thin, but what is covered is done well.

Additional Teacher Thoughts

Useful bibliography.



LESSON NINE

WHAT'S IN A LANDFILL?

Are There Alternatives?

LESSON SUMMARY

Students will learn about resource conservation by examining the recyclable, nonrecyclable, and organic components found in solid wastes discarded in a landfill. By sorting and classifying the packaging material from Lesson 5, students will know the meaning of the terms organic, recyclable, and nonrecyclable resources. Students will understand why different methods of disposal and recovery are needed for different solid wastes. Students will learn the function of a landfill.

Age	Grades K–2
Subject	Science, social science, mathematics
Skills	Observe, classify, organize, record data
Duration	Two 30-min. lessons prior to sorting solid wastes; landfill should take 30 min.
Group size	Class
Setting	Indoors: classroom (unless large compost trays are available for out door landfill)
County goals	Disposal; Resource Recovery
Vocabulary	landfill, compost, inorganic, organic, recyclable, nonrecyclable, reusable

LEARNING OBJECTIVES

On completion of this lesson students will be able to

1. Differentiate between organic and inorganic, recyclable and non-recyclable resources.
2. Observe, hypothesize, record, and discuss what they will see in the two mini-landfills in the large glass jars.
3. Draw a pictorial representation of the organic and inorganic solid wastes in the jars.
4. Classify the packaged materials as either organic or inorganic.

MATERIALS

-Four large, clear glass jars (Klaussen pickle jars work great!)

-Soil

-Garbage and trash from Lesson 5

-Magazine pictures or children's own drawings

-Drawing paper

-Crayons

BACKGROUND INFORMATION

A sanitary landfill is a place where solid waste is disposed of by spreading and compacting the waste in thin layers, then covering it with soil at the end of each day. Students should be helped to realize that solid wastes are made of a variety of natural resources. These solid wastes should be separated based on their composition as to whether or not they can be recycled or composted.

Explain to students that in order to minimize the amount of trash that has to be buried in the landfill, they can sort out the recyclables at home (source separation). It is very expensive to collect and bury our trash in the landfill. By sorting the material for recycling, the resources are reused and the cost of disposal at the sanitary landfill is reduced.

You can do this activity with two jars or four. If you choose two jars, label them **organic** and **inorganic**. If you choose four jars, add a **recyclable** and a **nonrecyclable** jar.

PROCEDURE

1. Review with the students the terms presented in the key vocabulary.
2. Put these terms on a language board: organic and inorganic. Hold up pictures or real items and separate them into organic or inorganic. Make a fun sheet with pictures of items to be classified.
3. Make a Venn diagram using organic and inorganic. Students can paste pictures of organic versus inorganic items on the Venn diagram. Make a Venn diagram page too.
4. The next day, do this same activity with the terms recyclable and nonrecyclable. Make a fun sheet with recyclable and non-recyclable items for sorting.
5. Using the packaging from Lesson 5, the teacher will sort the wastes into inorganic and organic and put them into the landfill jars. If the students are able to, now divide the inorganic material into recyclable and nonrecyclable. Which organic items are recyclable or compostable?

MANAGEMENT SUGGESTIONS

It would be advisable to use plastic gloves as the solid wastes from Lesson 5 will have been sitting for approximately one week. Tell students that they should not sort through trash without an adult's supervision. Set the inorganic landfill in a section of the room to be observed daily for at least one month. If you wish to make a compost for children to observe, you may choose to do so in a large glass jar as the decomposing will be rapid and "offensive" if left to the open air.

EVALUATION

Ask the students to name three things that are organic and three things that are inorganic.

Ask the students to tell you the names of three objects of solid waste that can be recycled.

SUGGESTED RELATED ACTIVITIES

1. Have the students draw a picture of what the contents of landfills look like on a daily basis for one week.
2. Weigh the soil before and after the week-long experiment.

FRAMEWORK REFERENCE

Science Framework Addendum (1984): p. 6 (Values, attitudes); p. 50 (Renewable, nonrenewable); p. 52 (Recycle)

History-Social Science Framework (1988): p. 6 (Citizen's responsibilities and civic values): p. 16 (Understanding human and environmental interactions)

SOURCE REFERENCE

This material borrowed and adapted from *A-Way with Waste* curriculum guide. A program of the Washington State Department of Ecology.

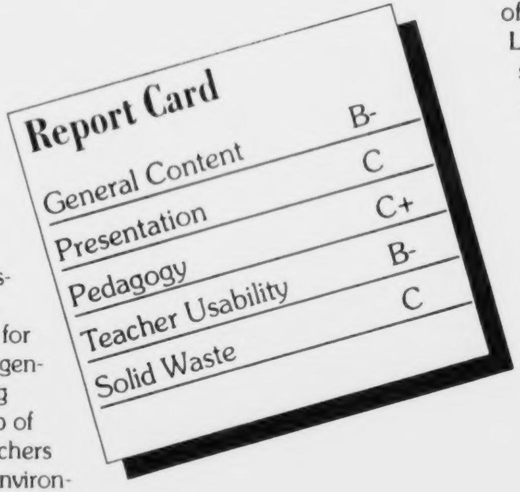
Super Saver Investigators

Super Saver Investigators
Ohio Department of Natural Resources
Division of Litter Prevention and Recycling
Educational Specialists: SSI
Fountain Square, Building F-2
Columbus, OH 43224
(614) 265-6333

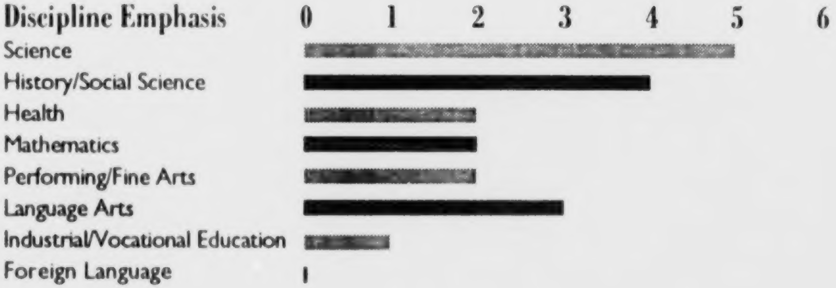
$25 check or money order,
single orders only.

An elementary, interdisciplinary, environmental studies activity guidebook about solid waste and natural resources that contains many hands-on, skill enhancing activities. The ideas for these activities were generated at a week-long workshop by a group of Ohio elementary teachers actively involved in environmental studies education. 384 pages, 1990.

Grades K-6.



Report Card	
General Content	B-
Presentation	C
Pedagogy	C+
Teacher Usability	B-
Solid Waste	C



Comments

General Content

Good flow of concepts which are explored in depth.

Presentation

Excellent concept and lesson organization indices. Printed on both sides of recycled paper. Adaptations for gifted students, but needs some LEP (Limited English Proficient) content. A very comprehensive presentation, linking social learning to environmental causes. Lessons grouped by topic. Not much stewardship addressed; mostly waste/recycling process oriented.

Pedagogy

Lots of good lessons, promoting active participation and utilizing cooperative learning groups. Culturally sensitive, quality student materials. Heavy emphasis on "table work," where completed handouts are the final product. Some good evaluations.

Teacher Usability

Excellent but confusing arrangement of materials. Would be easier to use if materials were divided into easy-to-find sections. Needs some background and resource material supplementation. Very complex teacher plans with a lot of material gathering required.

Solid Waste

Many concepts were covered in the intermediate, but not primary, lessons. Some household hazardous waste lessons are included.

Additional Teacher Thoughts

"Looks outdated and old, but it is more in line with our framework in flow and content than most I've seen." "Good content. Make it a little more 'teacher-friendly' and I'd use it." Oriented toward Ohio but easy to adapt, as it is very general.

TO BUY OR NOT TO BUY

CHAPTER 9

AR DAYS
SOUP · CEREAL
CANNED GOODS
JELLO
SHOP
WISELY
TO SAVE
RESOURCES
SALE

PRIMARY/INTERMEDIATE

Objectives Students will be able to (1) *classify* different types of packaging based on recyclability, (2) *describe* different reasons why products are packaged, (3) *identify* excess packaging that is unnecessary, (4) *make choices* based on a consideration of the environmental impact of actions. Students will improve their ability to *make consumer decisions*.

Method Students observe and classify a variety of packaging brought from home. They *identify alternatives* to consuming and producing unnecessary or wasteful packaging. They discuss and *write* creative ideas for commercials that may be produced in class.

Duration: six to eight class periods

Setting: classroom, home

Subjects: Social Studies, Language Arts

Curriculum Reference: 6.1

Preparation For Step 2: nut shell, orange peel, banana peel, clay pot, paper grocery sack, glass bottle, plastic bubble packaging from a toy, plastic milk container and styrofoam packaging.

For Step 5: a toy without packaging, identical toy with packaging.

For Evaluation Exercise: sock in a plastic bag, glass bottle, cereal in a box with "made from recycled paper" symbol on it, large can of pork and beans.

Vocabulary biodegradable, necessary, packaging, recyclable, unnecessary

Handout ***Making Wise Decisions***

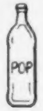
Procedures

1. Give students pre-test handout, ***Making Wise Decisions***. Collect after they have completed it to the best of their knowledge.
2. Tell the students that there are three types of packaging. Present them with examples of three types of packaging:
   a. a nut shell, an orange peel and a banana peel as packaging in nature.
   b. a clay pot, a paper grocery sack, and a glass bottle as examples of reusable and recyclable packaging (discuss the meaning of reuse and recycling).
   c. a plastic bubble used in packaging a toy, plastic milk container and styrofoam packing pieces as examples of packaging that are hard to recycle.
3. Announce that for the next week the students will be saving types of packaging to bring to school for further activities. Tell each student to place an empty grocery bag in the kitchen. As soon as Mom or Dad returns from the grocery store or department store, the student should help them unpack the goods and save the clean packaging to bring to school.
4. Divide the students into small groups of five or six and have them classify the packaging they brought to school into the three groups discussed in class (i.e., packaging from nature, reusable or recyclable, hard to recycle). Note and discuss which group had the most packaging. You may want to weigh each group's collection and compare.
5. Use the above activity as a springboard to discuss the following:
   a. Much of the waste materials each household

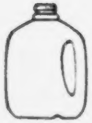
MAKING WISE DECISIONS

1. DRAW A LINE FROM THE DESCRIPTION TO THE PACKAGING IT DESCRIBES

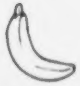
A. Packaging of nature



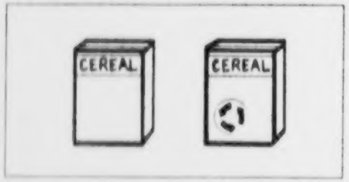
B. Can be reused or recycled

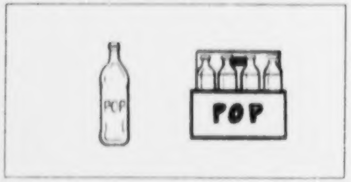


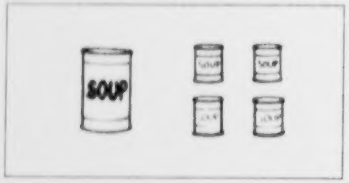
C. Hard to recycle

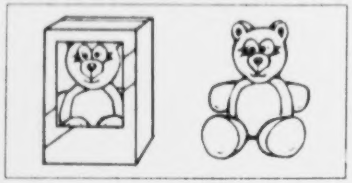


2. CIRCLE THE ITEM IN EACH OF THE TWO CHOICES THAT WOULD BE THE BEST CHOICE FOR SAVING NATURAL RESOURCES AND ENERGY







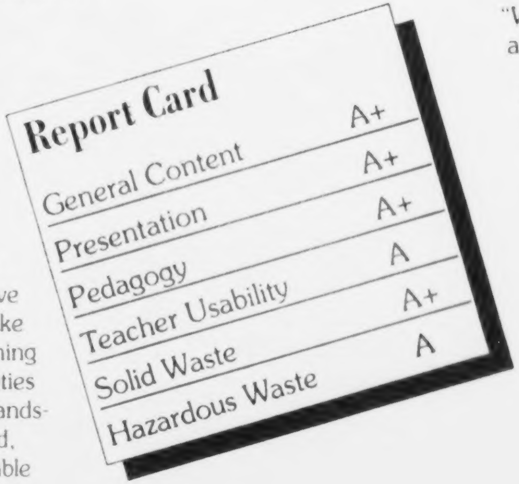


Closing the Loop

Closing the Loop
Integrated Waste Management
Activities for School and Home

The Institute for
Environmental Education
18554 Haskins Road
Chagrin Falls, OH 44023-1823
(216) 543-7303 Mary Chadbourne

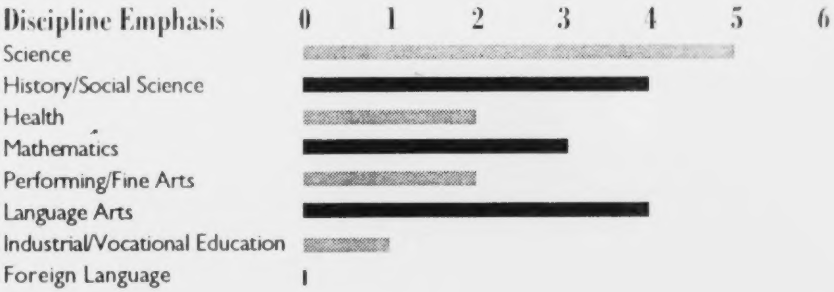
$32 for K-12.
$28 for K-8.
$26 for 9-12.



Report Card	
General Content	A+
Presentation	A+
Pedagogy	A+
Teacher Usability	A
Solid Waste	A+
Hazardous Waste	A

A collection of activities grouped under three thematic sections: Everything Ends Up Somewhere, We Have Options And We Make Choices, and Everything Is Connected. Activities are intended to be hands-on, problem-centered, practical, and adaptable across grade levels and subjects. 1991.

Grades K-12.



Discipline Emphasis

Comments

General Content

Offers a step-by-step way to have students, parents and teachers buy in to responsible waste management.

Presentation

"Weak in (materials for) LEP (Limited English Proficient) students - activities were nice, but directions would be hard to follow for some."

Pedagogy

"Outcomes of lessons are highly appropriate; results of the activities are usually an excellent measure of learning." "I like how it engages students to reflect on their own learning styles and the inherent responsibility they have for their own learning."

Teacher Usability

The numbering system for the book is too cumbersome. Some activities call for optional constructions which require some resourcefulness. Great teacher background and topic-specific resources at the end of each lesson. A large variety of materials; however, some teachers may find it overwhelming.

Solid Waste

The solid waste sections are exceptionally good.

Hazardous Waste

"Supplementary materials would be of value here." Not enough emphasis is given on the importance of following all handling cautions on toxic product labels.

Additional Teacher Thoughts

"The reproducible 'principles and conditions of learning' were outstanding and refreshing to read again." "Excellent, excellent, excellent! This covers many topics that we don't have listed. I want this one!"

SEPARATION MANIA

Grades: 5-8, but adaptable to all levels

Subjects: Science, mathematics,

Format: A series of activities to classify and separate waste by the most efficient means possible

SINKER OR FLOATER?

OBJECTIVE: Students will be able to (1) describe the function of various separation techniques in recycling processes; (2) make deductions from data to describe how physical properties of matter enable various separation techniques to be used, and (3) generally improve their problem-solving ability through practical experience.

METHOD: Students will describe physical properties of ten waste items on a data sheet based on their experience with several mechanisms that can be used to separate these waste items. They will be directed to make deductions from the information sheet and asked to design a separation process in stages, using mechanisms introduced previously. Students can work individually, in pairs, or in small groups to compete for the most efficient design. The judgement about which is the "most efficient" should be put to the test by classmates for their observation and measurement.

BACKGROUND: Understanding the physical properties of waste materials will help students to appreciate the ease or difficulty with which each is reused, recycled, or disposed. This activity addresses the ways that materials can be handled in order to be separated from each other for recycling or other alternatives.

MATERIALS:

- Rulers
- Metric scales
- A magnet (preferably a bar magnet be attached to a flat piece of wood)

Our thanks to the Ohio Department of Natural Resources for giving us permission to use this activity from their publication *Super Saver Investigators*

PROPERTIES OF WASTE OBJECTS

Question Name	Name of Object	Name of Object	Name of Object	Name of Object	Name of Object
Size (l x w)?					
Weight (oz.)?					
Magnetic?					
Nonmagnetic?					
Floats?					
Sinks?					
Shreds?					
Does wind blow it?					
Other?					

The No Waste Anthology

The No Waste Anthology
California Department of Toxic Substances Control
P.O. Box 942732
Sacramento, CA 94234-7320
(916) 322-0476

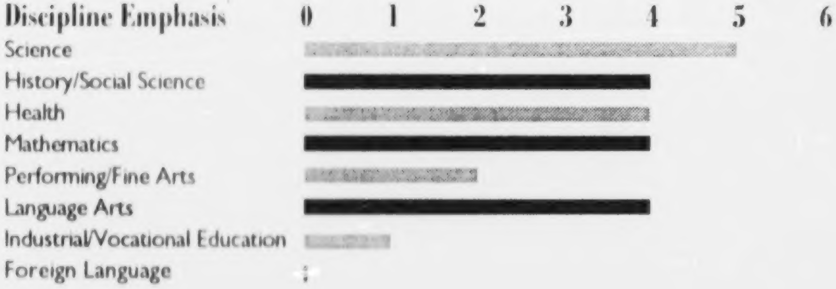
Free.

A compilation of interdisciplinary, action-oriented, cooperative problem solving activities focusing on pollution prevention. Divided into three sections: Natural Resources and Pollution, Solid Waste, and Hazardous Waste. 320 pages, 1991.

Grades K-12.

Report Card

General Content	A
Presentation	A
Pedagogy	A
Teacher Usability	A
Solid Waste	A-
Hazardous Waste	A



Comments

General Content

Well-balanced, comprehensive coverage of major environmental education topics in this anthology. Some activities ask students to make choices based on knowledge presented in later activities or not at all.

Presentation

Legible text and easy-to-grasp tables, charts, and illustrations.

Pedagogy

The evaluative devices for students are outstanding, using non-traditional ways to challenge kids to think, integrate their knowledge, and act appropriately. Science explorations are engaging and worthwhile.

Teacher Usability

Excellent list of resources. Concepts are cross-referenced. Could be better organized (i.e. according to grade level rather than subject area); teacher will have to sit down and map out course of study for their particular grade level before using.

Solid Waste

Doesn't teach composting.

Hazardous Waste

Does a good job explaining the three routes of exposure (to hazardous wastes) and of emphasizing precautions.

Additional Teacher Thoughts

"Very comprehensive resource, covering all areas of hazardous waste and solid waste in depth. Excellent teacher resource to use in developing a meaningful, sequential curriculum. Great activities!" Quotes from outside literature included in the lessons.

"Would love to see some of the activities simplified for younger students."

ECOLOGICAL PICNIC

Goals:
Students will plan and enjoy a picnic using a minimum of disposable items, then sort and recycle as much of the picnic garbage as possible

School Subject:
Science, Social Studies

Grades:
3rd - 12th

Time:
30 minutes for planning, 60 minutes for the picnic, and 30-45 minutes after the picnic

Materials:
- Typical lunch
- Two buckets or large cans for picnic garbage
- One bucket with a tight-fitting cover for composting
- Sawdust or dirt

BACKGROUND

People use disposable products for picnics and other occasions because there are no dirty dishes left over and no utensils that need to be taken home and washed Just toss the products away and they seem to disappear But there really is no "away" all garbage must go somewhere Any garbage that is not recycled contributes to the local landfill or becomes unsightly litter This activity reinforces the idea that students can make personal choices about their actions In this case they will be making choices that will minimize the amount of waste generated by a class picnic After the picnic, students will collect the garbage that remains and recycle or compost what they can

PREPARATION

Choose a site for the picnic (students may help choose) Possible locations are the schoolyard, a vacant lot, a park, a ball field, a lawn, or the side steps to the school building If the weather is not suitable for an outdoor picnic, move it indoors. Push all of the desks aside and have the picnic in the middle of the classroom floor Label the buckets to be used for garbage during the picnic The one with the cover should be labeled "Food" The other buckets should be labeled "Cans" and "Other"

PROCEDURE

Day One

1 Decide upon a typical lunch that students might bring to school Ask students to decide what items from the lunch would be thrown away Ask if any of the pieces of garbage could be reused or recycled Have students think of something that is reusable that could replace each disposable item (for example, flatware could be used instead of plastic spoons and forks)

2 Plan the picnic Ask students for ideas about how they can pack a lunch that will produce the least amount of garbage Explain that they will be making a friendship salad the day of the picnic and that they can contribute one or two pieces of fruit if they want to

3 Send the included letter to parents telling them of the picnic and asking for volunteers

Day Two

4 On the morning of the picnic, discuss garbage and cleanup Point out that some things will need to be thrown away even though the picnic was planned and choices were made so that there would be little garbage Show students the buckets or cans you want them to use for all of the garbage at the picnic Explain that one bucket is for recyclable containers, one is for other garbage like paper and plastic If there is water available at the picnic site, let students know that they can wash all dirty, reusable containers and utensils after the picnic

5 One or more of the parent volunteers can help small groups of students wash and cut the fruit during the morning Capture and reuse the water

6 Remember to bring the three labeled buckets with you Make sure students keep and sort their garbage after the picnic

7 After lunch call the students together Discuss what kinds of garbage are left over and what garbage isn't there because students made careful choices about what to bring Make sure when the class leaves that no garbage is left at the picnic site

After the Picnic

8 In the classroom put all of the food garbage from the picnic into the bucket for composting You can layer the food with sawdust or dirt, if either are available Make sure the cover fits tightly, open compost containers attract rodents and flies Stir the mixture every three to five days for a couple of weeks When most or all of it looks like dirt, use it Add a little soil and plant flowers in it or mix it into the soil under a favorite tree Let students know that compost is a kind of plant food, it contains many nutrients that plants use

9 You or one of the parent volunteers can take the cans to the recycling center in your area or take a field trip to the center Discuss with the students where the cans are going and why it is better for the environment to recycle cans rather than throw them away

10 Discuss with students what they did during the picnic that was good for the environment and good for people Let students express their ideas and feelings Discuss savings of paper (trees), plastic and money

11 Distribute paper and drawing materials and have students draw a picture of the picnic showing themselves and others doing something good for the environment Older students can label their own pictures, younger students will need to dictate a sentence or two

Discussion Questions

- What do you usually throw away after a picnic? - How could you pack a lunch for a picnic so you would have little or no garbage? - Why do you think people might want to use something that could be thrown away, even if they know it just makes more garbage? - Why is garbage bad for people, plants, and animals? - What kinds of garbage were left over after the picnic? - What other kinds of garbage might we have had if we didn't plan an ecological picnic? - What choices did you and other class members make that were good for the environment? Good for people?

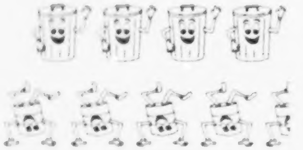
Adapted from **CALIFORNIA STATE ENVIRONMENTAL EDUCATION GUIDE, 1988**

A-Way with Waste

A-Way with Waste
(3rd Edition)

Washington State
Department of Ecology
3190 160th Avenue, S.E.
Bellevue, WA 98008-5452
Attn: Jan Lingenfelter
(206) 649-7043

$28.50.



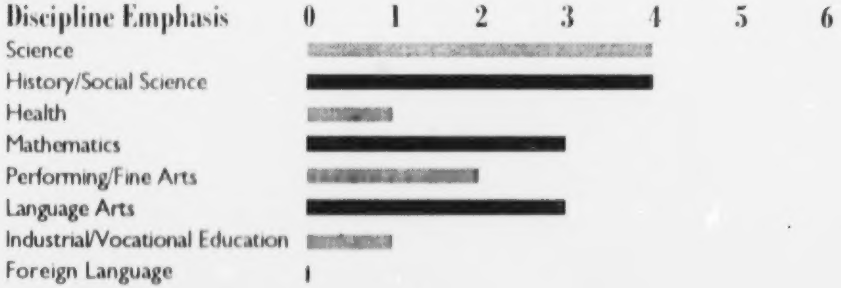
This curriculum is written and organized to present integrated waste management concepts affecting land, air, and water in the ecosystem. The activities are designed to promote awareness, attitudes, and actions to solve waste management problems at home, in school, and in the community. 570 pages, 1990 (an updated version set for release in September 1993).

Grades K-12.

Report Card

General Content	A
Presentation	A
Pedagogy	A-
Teacher Usability	A
Solid Waste	A-
Hazardous Waste	A-

Discipline Emphasis



Comments

General Content

Contains many good and engaging activities.

Presentation

Teachers must adapt lessons that span multiple grade levels. The presentation is clear and easy to use.

Pedagogy

Many lessons are activity-centered.

Teacher Usability

The instructions for procedures were not detailed enough in many cases. Contains an extensive glossary. "The best I've seen as far as teacher background."

Solid Waste

Good coverage of solid waste issues, with the exception of "Buy Recycled."

Hazardous Waste

Covers all issues well; however, hazardous waste disposal is covered better in the 7-12 materials.

Additional Teacher Thoughts

Specific grade level activities are difficult to pull out and relate to the overall picture in this format. Excellent bibliographies accompany each section. "One of the best."

Bikes And Byproducts

Subject: Science, Social Studies
Grades: 3-6
Teaching Time: One Class Period
Focus: Hazardous Waste, Natural Resources, Manufacturing By-Products

Rationale

Sometimes making the things we do want creates things we don't want such as hazardous waste

Learning Objective

Students will:

- Learn what the term "hazardous waste" means
- Learn some of the hazardous wastes created by the manufacturing of a bicycle

Materials

- Bicycle (select a student to bring one to class)
- Diagram "Bicycle Materials, Wastes & Byproducts"

Pre & Post Test Questions

1. What raw material is plastic and synthetic rubber made from?

2. What happens to hazardous industrial wastes?

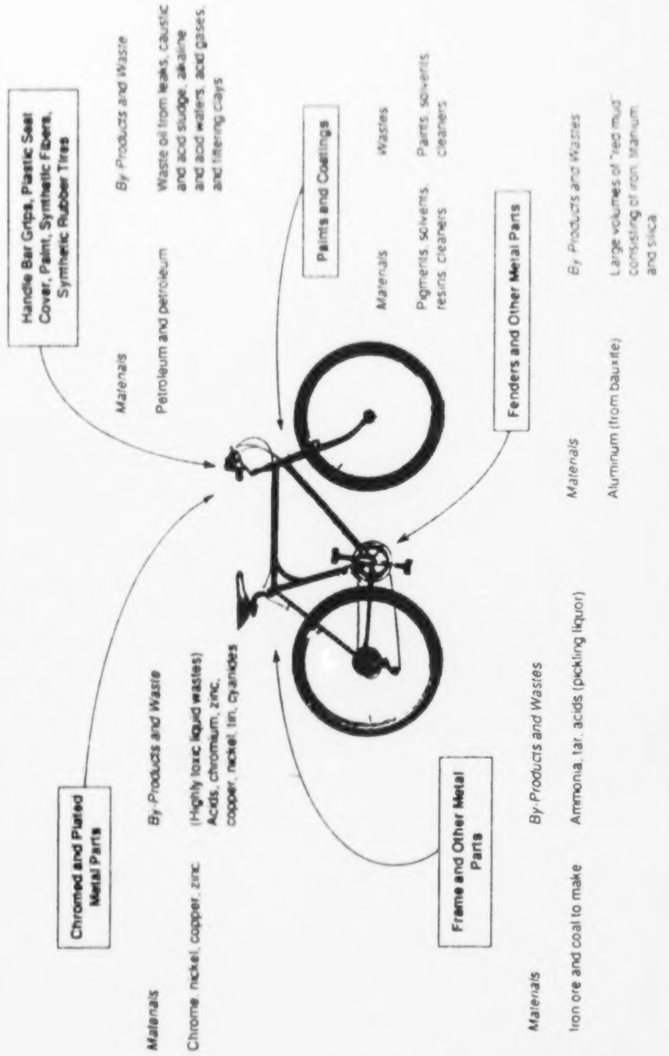
3. (3rd & 4th Grades) What is a natural resource? Name two

Learning Procedure

1 **Ask:** "How many of you have bicycles?" "Of what are they made?" "What are the frames made of?" "How about the tires?" "The handle bar grips?" "Where are the metal and rubber and plastic that go into bicycles made?" (In mills and factories that transform raw materials such as petroleum, bauxite and iron ore into bicycle components.) **Ask:** "What makes your bike special - different from others?" "How many different colors of bikes do we have?" "Whose bike is shiny?" "What is the shiny metal on bikes called?" **Ask:** "Which natural resources are used in the making of bikes?" (iron, petroleum - for plastics, synthetic fibers and synthetic rubber, petroleum distillates for paint and paint solvents, bauxite for aluminum, chrome, coal for coke to smelt the iron ore into steel and others.) **Ask:** "What had to happen to the natural resources before they could be used to build your bike?" (They had to be processed in factories.) Direct the discussion from here with the aim of having students realize that when natural raw materials are processed, by-products and waste, some of which may be harmful, are produced. **Ask:** "What are byproducts?" "For example, what byproducts are produced when you burn wood and paper in your fireplace or woodstove at home?" "Are some of these byproducts harmful?" "What kinds of things might be byproducts of the building of your bicycle?"

2 Distribute "Bicycle Materials, Wastes and By-products" (A diagram of a bicycle that lists some of the materials and byproducts associated with the manufacturing of bikes) or ask a student to bring his

Bicycle Materials, Wastes, and By-Products



Handle Bar Grips, Plastic Seat Cover, Paint, Synthetic Fibers, Synthetic Rubber Tires

Materials	By-Products and Waste
Petroleum and petroleum	Waste oil from leaks, caustic and acid sludge, alkaline and acid waters, acid gases, and filtering clays

Paints and Coatings

Materials	Wastes
Pigments, solvents, resins, cleaners	Paints, solvents, cleaners

Fenders and Other Metal Parts

Materials	By-Products and Wastes
Aluminum (from bauxite)	Large volumes of "red mud" consisting of iron, titanium and silica

Chromed and Plated Metal Parts

Materials	By-Products and Waste
Chrome, nickel, copper, zinc	(Highly toxic liquid wastes) Acids, chromium, zinc, copper, nickel, tin, cyanides

Frame and Other Metal Parts

Materials	By-Products and Wastes
Iron ore and coal to make	Ammonia, tar, acids (pickling liquor)

Think Earth!

Think Earth!
Environmental
Education Program

Education Development Specialists
5505 East Carson Street, Suite 250
Lakewood, CA 90713-3093
(310) 420-6814 Ann Crafton

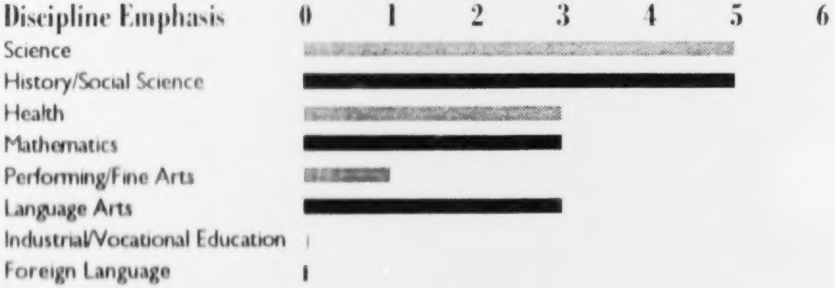
Call for cost information.

Three units that are interrelated and sequential, including a 27-minute video and individual grade packets containing teacher guides, blackline masters, and posters. 1993.

Grades 4-6.

Report Card	
General Content	A+
Presentation	A
Pedagogy	A
Teacher Usability	A
Solid Waste	A-

Discipline Emphasis



Comments

General Content

Connections are made between lessons and are articulated across three grade levels. Scope limited. Extensions are excellent.

Presentation

Beautifully designed and presented. Layout is appealing with colorful posters. Video presentation will initially stimulate children, although it is definitely in an upper-middle class setting.

Pedagogy

Could be improved by including more hands-on science. Emphasizes paper-and-pencil activities. Relies on multiple-choice, rather than open-ended questions. Little critical or creative thought. Hands-on activities tend to be extensions.

Teacher Usability

Good layout of concepts, skills, and behaviors. Excellent quality reproducibles. Good, colorful, engaging graphics and blackline masters.

Solid Waste

Included some information on household hazardous waste.

Additional Teacher Thoughts

"I personally do not like to see inappropriate responses reinforced by color, action, and sound. The students remember the response, but not always its context." "It is state-of-the-art in teaching how to care for the planet." "Amazingly effective to see specific resource conservation behaviors visualized. It makes all this intellectualizing grounded in the practical; the real world."

LESSON 2: Learning About Trash

Skill Outcomes:

1. Identify methods and problems associated with waste disposal.
2. Identify hazardous products.

Concepts:

1. The production, distribution, and consumption of products create solid, liquid, and airborne wastes.
2. The amount of waste we produce is increasing, not only because our population is increasing but also because each person is creating more waste.
3. Paper makes up about 40% of our solid waste; packaging of all kinds (paper, plastic, glass, metal) accounts for about 1/3 of our solid waste.
4. Most of our solid waste is buried in landfills, which are quickly filling up.
5. Some solid waste is burned to reduce its volume and to produce electricity.
6. There are problems with both burying and burning waste.
9. Some wastes are hazardous and must be disposed of in special ways.
10. Creating so much waste and improperly disposing of waste pollute our environment and cause other environmental problems.

Vocabulary:

- **decompose**—to rot
- **hazardous waste**—waste that is dangerous to people, animals, plants, air, water, or land
- **incineration**—burning solid waste, often to produce electricity
- **landfill**—open land where solid waste is buried
- **toxic**—poisonous

Materials:

- Poster—*Trash: Where Does It Go?*
- Mini-Poster—*Trash: Where Does It Go?*
- Hazardous Waste Product Cards
- Take-Home Exercise 2

Advance Preparation:

- Make a transparency of Take-Home Exercise 1: *What's in Our Trash?* or draw a large replica of the trash can on the chalkboard.
- Display the *Trash: Where Does It Go?* poster where all students can see it.
- Separate out the 8 product cards showing hazardous waste (indicated on the backs of the cards).
- Make a copy for each student of the *Trash: Where Does It Go?* mini-poster and of Take-Home Exercise 2.

Procedures:

A. Discuss Take-Home Exercise 1

- Ask students to get out their Take-Home Exercise: *What's in Our Trash?* Explain to them that they are going to "fill-up" the trash can that you've either drawn on the chalkboard or that is shown on the overhead transparency.
- Start with one section of the trash can and ask students to name examples that they found in their trash. As students give new examples, write them on the board or on the overhead.
- When the trash can is full, ask the following questions:

1. **What type of trash did you find the most of and the least of in your trash?**
(Answers will vary but most will probably be paper. Compare to the percentages on the exercise.)

2. **Could any of the paper we threw away be reused?**
(Answers will vary, but probably there will be some boxes and bags that can be used again, some paper that could be used to write on some more, some magazines that could be given to other people, and some newspapers that could be recycled.)

9. **What does "e" want Jeanie to do?**
("e" wants Jeanie to tell people about the environment and to find out what can be done to help.)

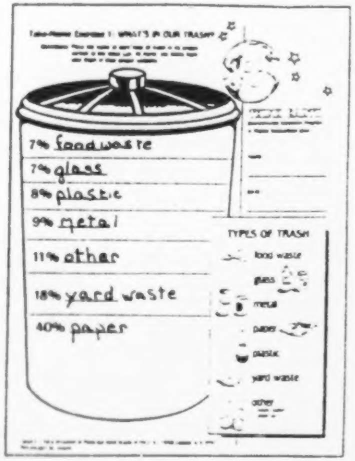
10. **What do you think we can do to help the environment?**
(Answers will vary. Some things have already been done. We have sanitary landfills now instead of just dumps. We have learned how to clean and reuse water. We have gasoline and cars that produce fewer air emissions, and some people are carpooling or riding public transportation.)

D. **Assign Take-Home Exercise 1**

- Hand out a copy to each student of Take-Home Exercise 1: *What's In Our Trash?*
- Point out to students that the trash can is divided into sections with the percentage of each section indicated. Tell students that they're going to guess what kind of trash belongs in each section, using the list of trash items shown next to the trash can.
- Start with the largest percentage (40%) and have students vote on which type of trash they think belongs in this section. Record the most common answer on the chalkboard. Continue to have students vote on which type of trash they think belongs in each section, and record their answers on the chalkboard.
- After students have voted on what belongs in all sections, sketch the trash can on the chalkboard and write in the correct answers (see answer key). Discuss differences between what the students thought and the correct answers. Have students write the correct type of trash for each percentage onto their Take-Home Exercises.
- Tell students that tonight at home, they are to look in their trash for examples of each kind of trash and to write those items in the appropriate section. For example, they might find a newspaper and a cereal box in their trash, so they would write "newspaper" and "cereal box" in the paper section of the trash can. Remind students to be careful when handling trash. Suggest that wearing gloves is a good idea.

E. **Conduct extension activities**

Note: *The additional activities in each lesson reinforce and extend the unit's concepts and behaviors. Some help students apply the concepts and behaviors to their own community. Others are of a "hands-on" nature. Use these activities as time and class interest permit.*



Take-Home Exercise 1: WHAT'S IN OUR TRASH?

7% food waste

7% glass

8% plastic

9% metal

11% other

18% yard waste

40% paper

- **Write stories.** Have students write and illustrate stories about what "e" has to say about the environment.
- **Fill and weigh trash bags.** Remind students that every person creates about [illegible] pounds of trash a day. Have students fill a large trash bag with trash until it weighs 4 pounds. Have students note how heavy the bag is and how much room it takes up. How many days do they think it would take for one person's trash to fill the classroom?
- **Examine trash from lunch.** Ask students to save all their trash from one day's lunch, whether the lunch was brought from home or purchased at school. Have students look at how much trash was created from lunch and determine how less trash could possibly be produced.
- **Review natural resources.** Hold up each of the product cards and have students determine what natural resource this product is mainly made from.

Waste Away

Waste Away
Vermont Institute of
Natural Science
P.O. Box 86
Woodstock, VT 05091
(802) 457-2779

$18.95 plus $3
shipping/handling

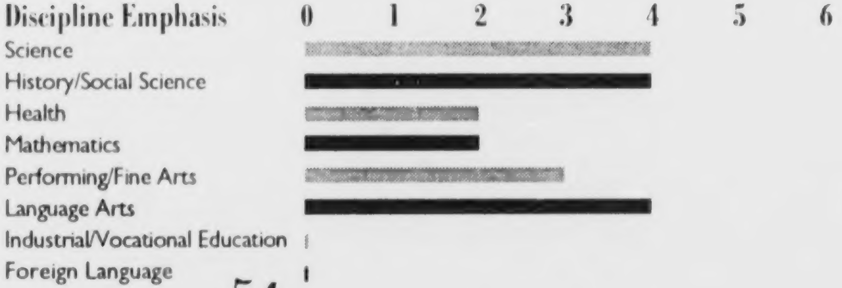
Waste Away is designed to educate upper elementary and junior high school students who will, in turn, educate their schoolmates, families and community about solid waste issues. May be easily adapted to a variety of grade levels. 120 pages, 1989.

Upper elementary and Junior High.

Report Card

General Content	A+
Presentation	A
Pedagogy	A
Teacher Usability	A-
Solid Waste	A-

Discipline Emphasis



Comments

General Content

A good variety of activities and strategies to get points and concepts across. Good integration of language arts. No science exploration except for classification and categorization.

Presentation

Strong in teaching students their roles as responsible consumers and citizens. It has detailed information on class, whole school, and community projects.

Pedagogy

There are excellent learning activities, many of which emphasize positive accomplishments children can make in their communities. Cooperative groups are used.

Teacher Usability

Great organization. Table of contents very helpful. Reproducibles are of good quality. Excellent appendix and teacher background.

Solid Waste

Presents a wealth of ideas for conducting a school trash festival. Covers all topic areas.

Additional Teacher Thoughts

"Written with a lot of love, research, and groundedness in the Earth." "Excellent! I want this one!" Four of six teachers found no weaknesses.

WASTE AROUND US Session III

Focus: We produce waste in all areas of our lives, therefore, we control how much is produced and can affect how much exists.

Subjects: Environmental education, math, language arts, social studies, science

Vocabulary: Litter, reduce, reuse, recycle, transport

ACTIVITIES

Materials

The Waste Puzzle ❤ ❤

Objective: To review the four Laws of Nature (Session II "Askami's Story," p 33) and illustrate how adherence to them can affect waste disposal

Procedure: Hand out the puzzle pieces. Explain that each child is needed to solve the waste puzzle. Put out four pieces of cardboard and explain that parts of the puzzle can be fit together on the cardboard to form 4 sections of the complete puzzle. (Each piece should be labeled on the back with a number indicating the section to which it belongs. After a little while, if necessary, mention the numbers on the backs of the puzzles. Eventually all the "1's" will fit on one piece of cardboard, all the "2's" on the next, and so on.) The four pieces of cardboard will then come together to solve the Waste Puzzle

- Waste Puzzle with enough pieces for each child, (model p.67)
- 4 pieces of cardboard

Discuss:

- ▲ the four Laws of Nature and ask the children to give examples for each
- ▲ which items are within the circle and why
- ▲ how the items on the outside could be changed or the use of them changed to put them inside the circle
- ▲ whether other equally useful objects could be substituted for those items outside the circle

Trash Patrol ❤ ❤

Objective: To examine where trash is around the school and help clean it up

Procedure: Explain that waste is all around us and that we would like to find out where it is around the school. Break the children into groups of three or four and give each group a bag. Lead students outside and head each group in a separate direction.

- large paper bags
- whistle
- newspaper
- 1 pair of dish gloves

❤ ❤ Activities for which volunteer assistance would be helpful

Trash Patrol (cont.) ❤ ❤

Instruct them to pick up anything they see that is litter. When they hear the whistle, they must return as quickly as possible (as a group) to you. Review the terms . . . biodegradable, recyclable, synthetic. Place newspaper on a table and dump the litter on top. Use dishgloves to protect your hands and examine the litter noticing the different types. Where was the litter found? Discuss why people litter.

Million Year-Old Picnic

Objective: To demonstrate that many materials are nonbiodegradable and will persist in the environment for many, many years.

Procedure: Tell the participants they are going to go on a Million Year-Old Picnic. One by one, pull out items from your bag and have the children guess how long they think each container will take to decay. Be sure they know what the material is. After all of the items are spread out, challenge them to arrange the items in an order that indicates how long they would take to decay.

- bag of items mentioned in "Waste Time Line" (p.63)
- decomposition rates (from "Waste Time Line" (p.63)

When complete, rearrange the items correctly and lead a discussion on biodegradability versus degradability. Explain that while the plastic items may not be visible over time, they do not truly biodegrade (see background information p 29). Also consider the effect of landfills on biodegradability (see background information p 48).

Ask the children to rearrange the items in order of best to worst for the environment considering as many factors as possible. Re-sort if necessary and discuss factors such as resources consumed, toxic waste from production, energy consumption, pollution, ozone depletion and how easily recycled.

[Adapted with permission from: Miller, L. H. *The Nature Specialist* Martinsville, IN. American Camping Association, Inc., 1986, 170 pp ($29.95).]

How Much Is It?

Objective: To visually demonstrate how much trash each person is responsible for producing every day and what the cumulative effects are.

Procedure: Weigh empty box first and adjust the scale so that the weight of the box is not measured. Have children estimate how much of the box would be filled to create 3.5 pounds of trash. Have children take turns adding to the box until the scale reads 3.5 pounds. Explain that this is how much trash the average American throws out at home in one day. Fill the box until the scale reads 5.5 pounds. Explain that this is approximately the amount of trash created per person in this country each day if restaurant, industry, government and business trash were taken into account. Estimate how tall a stack of boxes the whole class would produce each day. Then estimate for the whole school, town, and country. Discuss predictions for the future.

- large bag of assorted trash
- 1 large box
- scale

Teacher's Resource Guide for Solid Waste and Recycling Education

Association of Vermont Recyclers
P.O. Box 1244
Montpelier, VT 05601
(802) 229-1833 Ivy Zeller

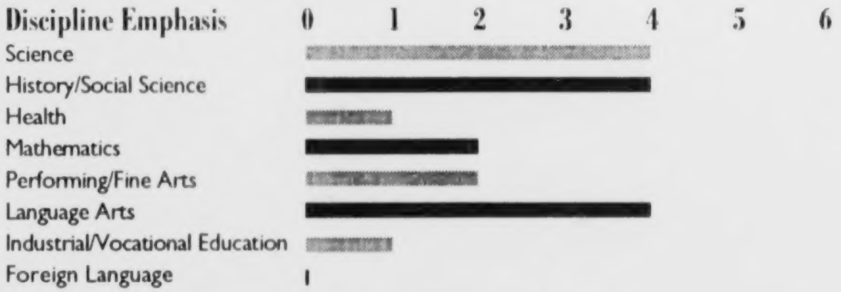
$45.

This guide is designed to help Vermont teachers integrate solid waste and recycling education into their existing schedules and required courses. It is divided into grade level sections (K-3, 4-6, 7-8, 9-12), and includes large information and resource sections. 1989.

Grades K-12.

Report Card

General Content	A
Presentation	A-
Pedagogy	A-
Teacher Usability	A+
Solid Waste	A-



Comments

General Content

Would be improved by increasing emphasis on students helping to make personal and institutional change. There are not many activities, but what is there is good and interesting.

Presentation

Lessons are "kid-friendly," but student pages don't leave enough room for them to write. Nice layout and presentation of interesting activities. Materials are professionally typeset and printed on both sides of 100% recycled, heavy stock paper.

Teacher Usability

Materials are well-organized and "teacher-friendly," with good background information and an outstanding resource guide. Some resources are specific to Vermont, but much is general in geographic applicability. A lot of reading is required to initiate/complete some activities. Some reproducibles are too "busy" and won't reproduce clearly. The format is very easy to follow.

Solid Waste

Specific content is very comprehensive.

Additional Teacher Thoughts

The section on Vermont resources and specific information could be modified or even deleted without damaging this document's integrity. "Well thought out from start to finish." "An excellent information source."

PAPERMAKING 4-6 ● III.B.2

Concept
Our natural resources can be reused and recycled into new and useful products.

Objective
Students will learn how paper is recycled.

Method
Students will make their own recycled paper.

Materials
Scrap paper (preferably white ledger paper, construction paper for coloring), decorative filler scraps (flowers, seeds, pine needles, small pieces colorful paper, yarn, thread, feathers, etc.), two wooden frames the same size, nylon fly screening or substitute, many absorbent rags at least as large as the frames, one wash basin, blender, sponge.

Subjects
Art, Science.

Skills
Designing, experimenting, observing, predicting.

Time
Two hours.

Source
Ontario Science Centre.

Resources
American Paper Institute; Vermont Department of Parks and Recreation; Vicki Cobb, *The Secret Life of School Supplies*; Leonard Fisher, *The Paper Makers*; Gail Gibbons, *Paper, Paper Everywhere*; Arnold E. Grummer, *Paper By Kids*.

AVR Guide Resources
PARALLEL ACTIVITIES
9-12 ● III.B.1 Recycling Paper Pollution.

INFORMATION
I.A.5.a Paper;
III.B. Recycling.

RESOURCES
C.5 Recycling.

BACKGROUND
The trickiest part of making paper is finding enough absorbent material to sop up all the water. Make sure to have plenty of sponges, sheets and towels handy. (You might want to have each child bring in his or her own toweling.) Avoid using newspaper if possible. Newsprint will turn everything dark grey, and if you dry on a sheet of newspaper, you will not be able to recycle it! If you would like everyone in the class to get a chance in one class period, you might want to set up stations around the class, so that there is one basin with mould and deckle for each four to five students.

LEADING QUESTION
Why should we recycle paper?

PROCEDURE

1. Explain the process of making paper.

2. Follow the attached directions to make a sheet of paper. Emphasize the reasons for recycling: resource conservation, less energy used, less waste needing landfilling. Also discuss the related problems of water pollution, contaminants, paper grades, costs of collection and transport, etc.

EVALUATION
What are the steps required to turn waste paper into new paper? What are some of the problems in recycling paper?

EXTENSIONS
A. Children can write poems (e.g. Haiku) or try calligraphy on their aper (if you use pens or pencils that do not bleed).

B. Contact the State of Vermont Recycling Hotline (1-800-932-7100) and learn what types of paper are commercially recycled, how to prepare the paper for recycling, and where the closest paper recycler is.

C. Weigh all the waste paper your class generates in a week. Separate the recyclable portion, and weigh the remainder to see how much the class can save for recycling. Have a contest with another class to see who can save the most.

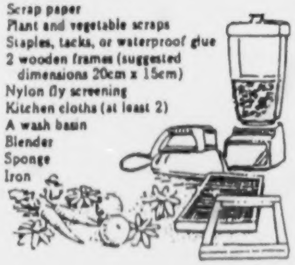
Vocabulary: papermaking, mould, deckle, pulp, screen.

PAPERMAKING 4-6 ● III.B.2

PAPERMAKING AT HOME

Equipment

Scrap paper
Plant and vegetable scraps
Staples, tacks, or waterproof glue
2 wooden frames (suggested dimensions 20cm x 15cm)
Nylon fly screening
Kitchen cloths (at least 2)
A wash basin
Blender
Sponge
Iron



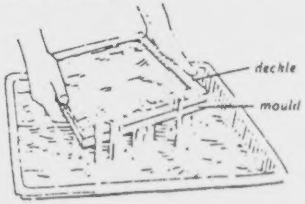
1 To make paper you must first make a 'paper mould' - a wooden frame with nylon fly screen stapled tightly to it. You can use a second wooden frame (deckle) without the fly screen to help make your paper more even.

2 Take some scrap paper, remove any plastic or staples, tear it into small pieces (about 2 cm square) and soak it in hot water for half an hour.

3 Take a handful of the soaked paper and put into a blender about half-full of warm water. Blend at a moderate speed until you no longer see pieces of paper. (If you have problems, take out some of the paper.) To this mixture (pulp) you can add small amounts of vegetable material like orange peels, carrot tops or flowers, and blend again.

Colouring the Pulp: If you want coloured paper, you can add fabric dye to the pulp. Make sure the dye is non-toxic.

4 Pour the mixture into a large plastic basin, half-full of warm water. Increasing or decreasing the amount of the pulp will affect the thickness of your paper.



5 Place the deckle on top of your screen. With both hands, dip the mould into the basin and scoop up some of the pulp. Gently shake the mould back and forth to get an even layer of fibres on the screen. When the water has drained through, place the mould to one side and carefully lift off the deckle, leaving the just-formed sheet on the screen.

6 To remove the paper from the screen, lay a clean kitchen cloth on a flat table, then take the screen and lay it face down on the cloth. Soak up any extra water from the back of the screen with a sponge. Very gently lift the screen the paper should remain on the cloth.

7 To dry the paper quickly, cover it with another cloth and iron at a medium dry setting. Once dry, pull gently on either side of the cloth to stretch it - this helps loosen the paper from the cloth. Gently peel the paper off.

8 A CLEAN UP NOTE: When you've finished, collect the left over pulp in a strainer. Be careful NOT to pour pulp down the drain - it might block it. The strained pulp can be thrown out or kept in a plastic bag in the freezer for the next time.

Bibliography

Heller, Jules.	*Papermaking.* New York: Watson-Guptill, 1978.
Hunter, Dard.	*Papermaking: the History and Technique of an Ancient Craft.* 2nd ed. New York: A. Knopf, 1947. Reprinted: New York, Dover Publications, 1978.
Studley, Vance.	*The Art and Craft of Handmade Paper.* New York: Van Nostrand Reinhold, 1977.

If you have any suggestions or require more information, write to:
The Printed Word,
Printing and Papermaking,
Ontario Science Centre,
770 Don Mills Road,
Don Mills, Ontario.
M3C 1T3

ONTARIO SCIENCE CENTRE

Mobius® Curriculum
Understanding the Waste Cycle

Browning-Ferris Industries
P.O. Box 3151
Houston, TX 77253
Attn: Tish Penn
1-800-BFI-8100

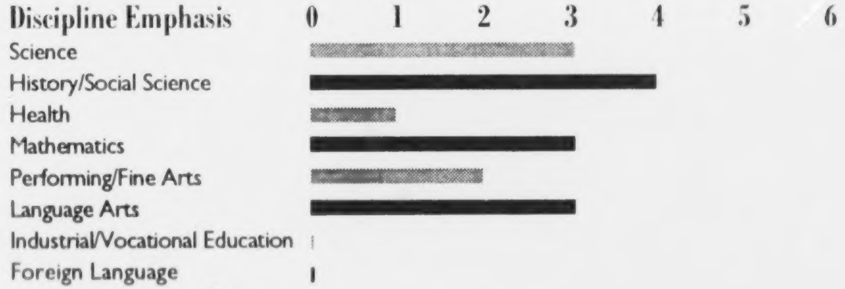
Free to teachers.

This curriculum focuses the "3Rs" through the subjects of science, mathematics and social studies. It can be used as part of your teaching plan or taught as a separate course. The worksheet packet at the back of the book offers a collection of exercises with varying degrees of difficulty for extra credit or extension activities. 121 pages plus handouts, 1992.

Grades 4-6.

Report Card

General Content	A
Presentation	A-
Pedagogy	B+
Teacher Usability	A
Solid Waste	A-



Comments

General Content

In-depth lessons which provide super integration into all other subject areas.

Presentation

In recycled plastic binder, but attempts to justify printing on one-sided paper and the use of virgin paper. Gave room for objective consideration of different points of view, but a little too dogmatic regarding landfills. Lists vocabulary as a concept/skill. Attractive, highly readable presentation generates enthusiasm. Adaptation for language minority students needs to be addressed.

Pedagogy

Knowledge is gained through teacher reading to class or teacher downloading of facts. Good use of open-ended questions on tests; good pre- and post-tests. Reading about science is not science. Needs more attention to cultural sensitivity. Lots of word searches.

Teacher Usability

Very usable curriculum - in addition to subject disciplines, concepts and skills are listed. Good layout for teachers, easy to follow, with most materials provided. Excellent resource lists.

Solid Waste

Could stress the importance of buying recycled more.

HAIRPIN CURVE AHEAD

Chapter One
Lesson Two:

Where Does Our Trash Go?

Concepts and Skills Addressed:

Vocabulary
Interpersonal Communication
Class Discussion

Materials Needed:

None

Materials Supplied:

Teacher background information on landfills, solid waste incinerators, and composting. Diagrams of a landfill site, a solid waste incinerator, and a compost pile suitable for copying or overheads.

Students will learn the benefits and limitations of three of the four methods of solid waste disposal: sanitary landfills, incineration, and composting. (The fourth, recycling, is discussed at length in subsequent lessons and chapters.) They will learn:

The five points about landfills:

a. They are the most common form of waste disposal.
b. They are constructed on carefully chosen sites and lined to protect the environment, which is why they are called "sanitary." Waste deposited in landfills is covered daily with soil.
c. They are different from dumps, which are being phased out in the United States.

d. They are filled by trucks hauling garbage to the site, where it is spread out, covered with soil, and crushed and compacted with heavy equipment. Rainwater and liquids from the decomposing waste combine to create **leachate**, which collects at the bottom of the landfill. Leachate is pumped out and treated in a **sewage** treatment facility.
e. They create gases as the organic material **decomposes**. Half of this gas is **methane**, which is **combustible** and can be used as fuel. The rest of the gas is **carbon dioxide**; it, too, can be recovered and used for industrial purposes.

LANDFILL
INCINERATOR
COMPOSTING

The four points about waste-to-energy:

a. It is a means to burn, or incinerate, garbage to ashes, which are taken to a landfill.
b. It creates heat to make steam that can drive machinery capable of producing electricity.
c. It reduces the volume of waste that is incinerated by 90 percent.[10]
d. It does not eliminate the need for landfills to dispose of the ash or other non-combustibles, like cement and gravel.

The three points about composting:

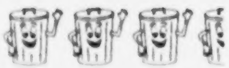
a. It makes use of organic materials such as yard waste, food scraps, and other plant and soil materials.
b. It decomposes to create a useful, enriching soil additive called **humus**.
c. It saves space in landfills by recycling organic material.

A. Procedure:

1. Read the background information on landfills, incineration, and composting.
2. Use the diagrams to help explain the main points mentioned above.
3. There may be examples of each of these disposal methods in your area or your school yard. Consider a field trip to a nearby landfill or incinerator. Walk through the school yard to see how leaves and other organic materials are decomposing right under our feet.
4. Check the students' knowledge by clarifying the five points about landfills, the four points about waste-to-energy, and the three points about composting.

Solid Waste Activity Packet for Teachers

Solid Waste Activity Packet for Teachers



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Mathematics, and Environmental Education
The Ohio State University
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Columbus, OH 43212
(614) 292-6171

Call for ordering
information.

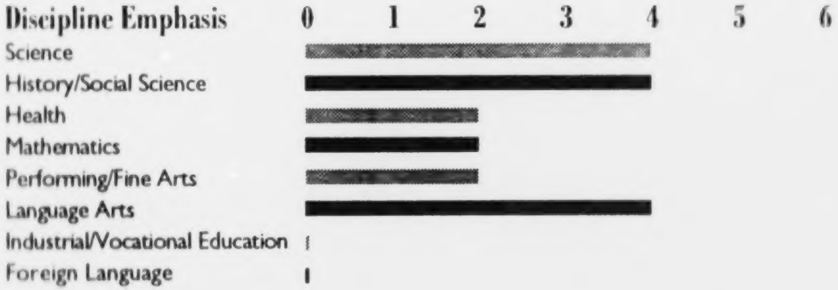
A compilation of materials adapted from other states on solid waste management education. Divided into seven sections: Introductory Materials, Reducing, Reusing, Recycling, Landfilling, Incineration, and Teacher Resources. 100 pages, 1990.

Grades 3-5.

Report Card

General Content	A-
Presentation	B+
Pedagogy	B+
Teacher Usability	A
Solid Waste	B

Discipline Emphasis



Comments

General Content

Addresses school and student involvement. Uses mainly language arts activities to develop concepts. Lacks good science activities. Concepts often do not develop sequentially. Many extended learning activities.

Presentation

Printing on hand-drawn art is a little hard to read. Some activities are engaging.

Pedagogy

Has up-to-date information for gearing up student involvement in resource conservation, composting, recycling, and purchasing programs on campus. Too teacher-directed; not enough inquiry or hands-on science. Misses opportunities for students to generate and use data.

Teacher Usability

Layout is somewhat confusing, and varies from lesson to lesson. The teacher background is hard to follow at times. Resource section is specific to Illinois. Excellent overheads for classroom discussion prompts are included in the appendix.

Solid Waste

Short but comprehensive, covers the basics thoroughly. "Omission of problems and time involved in siting a new landfill should be dealt with in the next revision."

Additional Teacher Thoughts

"Some great crafts projects." "A collection of many interesting environmental activities...using group activities, active learning, and critical thinking. Could stand alone as a 4-6 solid waste curriculum or better, be used as a valuable addition to a wider course of study." "Super teacher resource for 4-6."

CRAFTS FROM TRASH

Age: 5-12 years old

Goals: To help children learn that many items can have more than one use, and that the longer you keep an item out of the waste stream, the better it is for the environment.

Background:

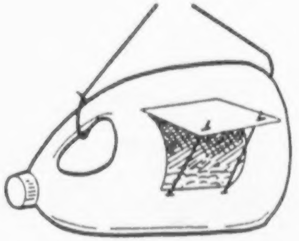
Many containers can have their "lives" and usefulness extended by finding creative ways to reuse them. In this activity, children will learn to make toys, musical instruments, piggy banks and bird feeders from common household trash.

Recycle for the Birds

Materials:

clean household containers:
  milk, detergent and bleach bottles
  milk cartons
  coffee cans
  pie tins
  onion sacks
mustard jar lid (for tracing circles)
sticks or dowels (for perches)

knife
hammer
nails
wire cutters
pencils
ruler
light wire
coat hangers

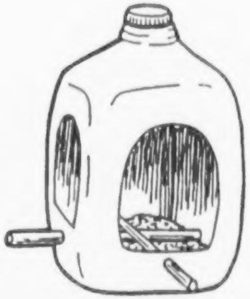

Bleach bottle feeder

Procedure:

1. Create bird feeders out of clean household containers using the drawings for models. Assist younger children with the cutting. Remember to punch small drain holes in the bottom of the containers to let rain water out.

2. Discuss the proper locations for installing the feeders with your group and the types of bird feed to put in each container. Inform them of their responsibility for maintaining a continuous supply of food once feeding is started and the importance of keeping the feeders clean.

3. Discuss the importance of reusing materials and develop a list of common items that can be reused and the new use(s) for each.

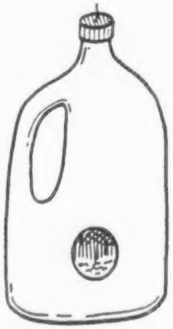

Milk jug feeder

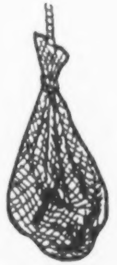
Going Beyond:

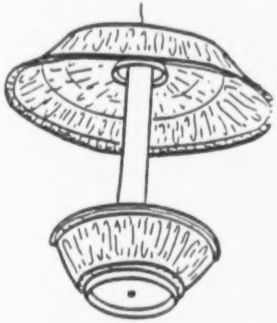
- Design and create bird houses out of natural or man-made containers.

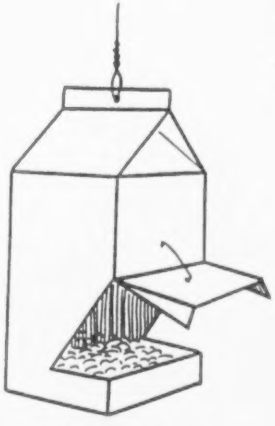
- Provide string, old yarn, baler twine, cloth strips, etc. for nesting materials. Wind these through an onion sack and hang the sack on a coat hanger.

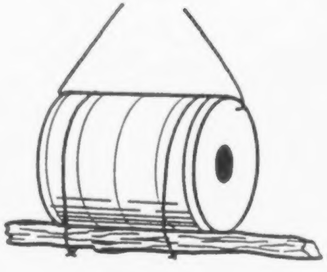
- Donate feeders to nursing homes and maintain them.


Detergent bottle feeder


Onion sack suet feeder


Pie plate feeder


Milk carton feeder


Coffee can feeder

Reprinted with permission from: Wisconsin Department of Natural Resources, Bureau of Solid Waste Information and Education, P. O. Box 7921, Madison, WI 53707.

Household Toxics

Household Toxics
Solid Waste Services of the
Municipality of Anchorage
P.O. Box 196650
Anchorage, AK 99519-6650
(907) 561-1906 Bill Kryger

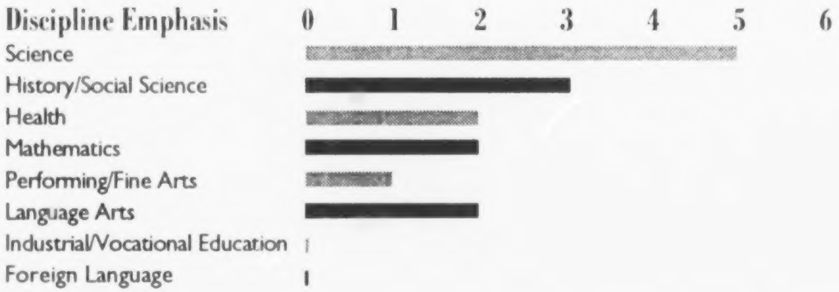
$25 plus shipping.

A science-based curriculum specifically written for Anchorage. Intended to educate students on the everyday use of hazardous products in the home and the consequences of improper disposal. 1989.

Grades 5-6.

Report Card

General Content	B
Presentation	B
Pedagogy	B+
Teacher Usability	B+
Hazardous Waste	B+



Comments

General Content

Excellent activities. Very science-oriented.

Presentation

Main concepts are clear. Presentation of material seems inappropriate for grades 5 and 6 - difficult reading level, unattractive handouts, etc. The lessons are very dogmatic. "I am not comfortable with their interchangeable vocabulary as stated on page vi (hazardous = toxic = poisonous = contaminant) - leads to imprecise student vocabulary development."

Pedagogy

Science activities are scripted and hinder student discovery and inquiry. Information and knowledge come through reading and teacher-led discussions rather than inquiry or experiences. Evaluation is given in terms of "list" and "name" - there is no application of acquired knowledge.

Teacher Usability

Good layout for teachers to follow for each lesson. "Lesson objectives almost like a script, not appropriate." Directions are very clear, and questions are specific. Materials listed are based on those available to teachers in the Anchorage School District.

Hazardous Waste

"Hands-on experiments teach the hazards of mixing toxics with soil and water, better than a thousand words."

Additional Teacher Thoughts

"Units give specific information to conditions in Anchorage, AK, which can heighten student interest. Makes me want to do the same for Salinas. Lessons are general enough to be applicable anywhere."

LESSON 9: FOLLOWING A PLUME

CONCEPT:

Contaminated groundwater forms a plume that travels with the flow of the aquifer.

ACTIVITY:

Students observe a simulation of groundwater contamination by using an "Ant Farm"-like model. It shows a cross section of a miniature aquifer and the movement of a plume of red dye.

TIME NEEDED:

15 to 20 minutes setup
approximately 30 minutes for one run or round
10 minutes follow-up discussion
15 minutes cleanup

MATERIALS: (see diagram)

"Ant Farm"-style model on stand
Hypodermic needle
Red food coloring
Plastic tubing
Eye dropper or straw
2 pinch style clothespins
Paper clip, straightened
2 clear plastic food containers or jars
Tap water
Overhead transparencies:
    "How Plumes Enlarge"
    "Contaminated Groundwater and Effects on Drinking Water Wells"

Diagrams: equipment setup, student observation samples

--from you--

Water based magic marker(s)--not permanent
Clock to time data-taking
Props to elevate apparatus
Paper and pencils for timers and observers

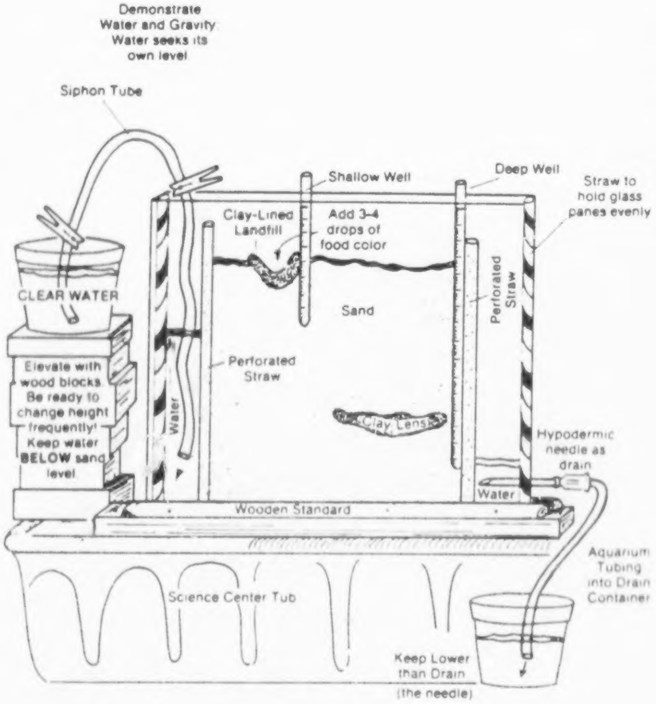
PREPARATION:

Setup equipment as shown in diagram.

Siphon to get intake water flowing: submerge tube until filled with water (no bubbles), seal ends with finger tips, and place one end under water in supply container and other end into intake chamber. The level of the supply container must be higher than the intake chamber of the "Ant Farm" model. Assign a person or two to time and record data for the next half hour.

DIAGRAM
Lesson 9

SET UP FOR "ANT FARM" STYLE GROUNDWATER MODEL


Demonstrate Water and Gravity Water seeks its own level
Siphon Tube
Shallow Well
Deep Well
Straw to hold glass panes evenly
Clay-Lined Landfill
Add 3-4 drops of food color
CLEAR WATER
Sand
Perforated Straw
Perforated Straw
Elevate with wood blocks. Be ready to change height frequently! Keep water BELOW sand level
Water
Clay Lens
Hypodermic needle as drain
Water
Wooden Standard
Aquarium Tubing into Drain Container
Science Center Tub
Keep Lower than Drain (the needle)

Teaching Toxics

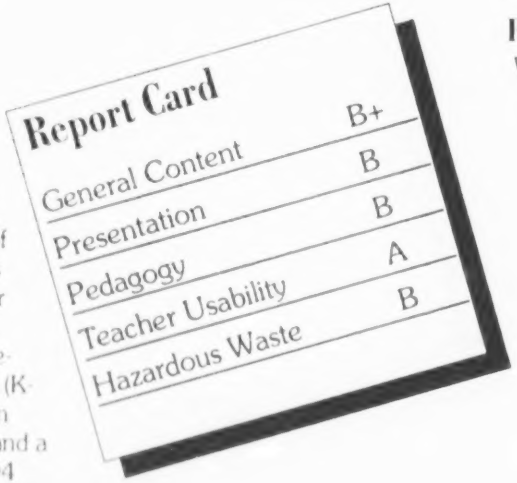
Teaching Toxics
Creating Solutions to
Household Pollution

The Association of
Vermont Recyclers
P.O. Box 1244
Montpelier, VT 05601
(802) 229-1833 Ivy Zeller

$25

A collection of activities which enable students to become aware of the environmental and health impacts of household hazardous wastes. Designed for Vermont teachers, it consists of four grade-level activity sections (K-3, 4-6, 7-8, 9-12), an information section and a resource section. 104 pages, 1992.

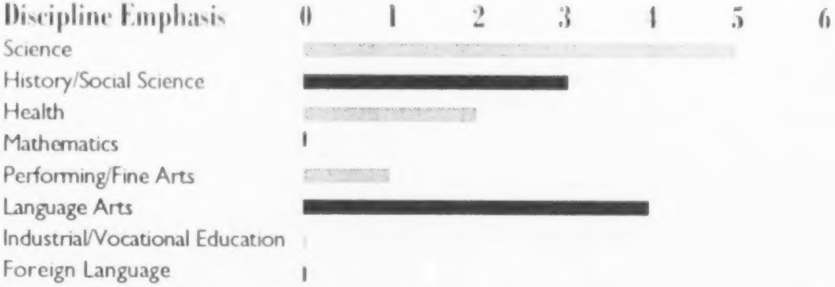
Grades K-12.



Report Card

General Content	B+
Presentation	B
Pedagogy	B
Teacher Usability	A
Hazardous Waste	B

Discipline Emphasis



Comments

General Content

Activities are articulated across grade levels, and show good progression of sophistication. Too brief, could have more activities per grade level. Contains good science activities.

Presentation

Well organized, and nicely laid out.

Pedagogy

It would be nice to see more group-oriented exploratory learning activities. Active learning is emphasized in engaging activities. While no evaluation devices are given as such, they would be easy to construct.

Teacher Usability

The information section can be relied on for solid facts. Good layout of teacher preparation information. Lessons are separated by grade levels. Includes a very comprehensive resource list.

Hazardous Waste

Industrial and business hazardous waste are not addressed. Disposal information is lacking. Motor oil life history cards for students are enlightening.

Additional Teacher Thoughts

There are not enough activities at the 4-6 level to teach all aspects of hazardous waste (as outlined in the evaluation questions). The information section at the end compensates somewhat, but not enough. This curriculum is short and concise and wouldn't take a lot of time to teach, but only covers concepts once.

4 - 6 : Looking at Labels

Subjects

Practical Skills, Social Studies, Science, Language Arts

Skills

Defining, observing, classifying

Materials

Product Labels, hazardous product advertisements from housekeeping magazines, sale and department store flyers from hardware and paint stores (teacher or student provided), optional: "Mr. Yuk" stickers (available from Vermont Poison Center), empty product containers

Time

Two - three class periods

Vocabulary

Hazardous, toxic, flammable, corrosive, reactive, potential, danger, warning, caution, symbol, ingredient

Related AVR Guide Activities

K - 3 Warning Words

Source

Adapted from *Slewth: Educational Activities on the Disposal of Household Hazardous Waste*

Concept

Certain information must appear on hazardous product labels.

Objective

Students will determine how to identify a hazardous product by examining product labels.

Background

Please see Information Section,pages 80-81. The Federal Hazardous Substances Act requires that certain information appears on the label of hazardous products. One of the "signal words" ("caution," "warning," or "danger") must appear on the front of the label. The label also must describe the types of hazards associated with using the product (flammable, toxic, reactive, corrosive), and give instructions for safe use. The exact product ingredients, however, are not legally required to be listed on the label.

Activities

What's On a Hazardous Product Label?

- Ask students if they know what to look for on a product label to see if it contains hazardous ingredients. As a class, make a list of things you would want to know about a hazardous product.

- Working in small groups, have students should use the Product Labels on pages 21 and 22 to answer the following questions:
  - — What type of product is this? What job does this product do?
  - — What information tells you that this product contains hazardous ingredients?
  - — What are the ingredients in this product?
  - — Summarize the label directions on how to store and dispose of this product.

As in real life, students will not be able to answer all the questions all of the time.

- After students are finished, discuss as a class what type of information they found on the labels. Compare the information given on the labels to the above list. What other types of information (that was not on the label) would be useful to know about the product?

Analyzing Advertisements

- Have students collect advertisements of hazardous products.

- As a class, discuss the information in the shaded box.

- In small groups, challenge students to analyze the hazardous product advertisements they collected. Small group discussion questions:
  - — Look at the advertisements your group has collected. Do any similar themes appear? How are they similar?

The following techniques are often used by advertisers to sell a product:

Convenience — it will save you time, and it is easy to use.

"Band Wagon" — most people believe in or accept it.

"New and Improved" — the old product is no longer adequate.

Luxury Image — using this product will help you achieve the finer things in life.

Appeal to Economic Values — it makes good economic sense to use this product.

Testimonial (endorsement by famous individual) — if this famous person uses it, you know it must be a good product.

"Plain Folk" (focusing on the average person) — people just like you use this product.

"Card Stacking" — distort or suppress the facts to make the product look better than it is.

Association — associate an object, person or an idea with something good or bad.

Comparison to Leading Brand — this product is just as good as the number one product.

- — Choose three advertisements or product labels. For each advertisement, answer the following questions.
  - A. What type of technique(s) is the manufacturer using?
  - B. What claims are being made about the product?
  - C. What is not being mentioned about the product?
  - D. Who would be most likely to buy this product? How are the advertisers gearing this information to the consumer?
  - E. If you are looking at a product label, compare the cautionary information to the advertising information.
  - F. Compare the advertisement to the information that is legally required to be on a hazardous product label.

Label Redesign

- In small groups, have students choose one of the products they examined. Students should redesign the product's label and an advertisement for the product so that it gives equal information on safety issues and product contents as it does on the product's performance.

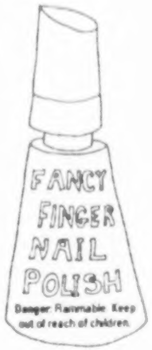
- Students groups should share their designs with the whole class.

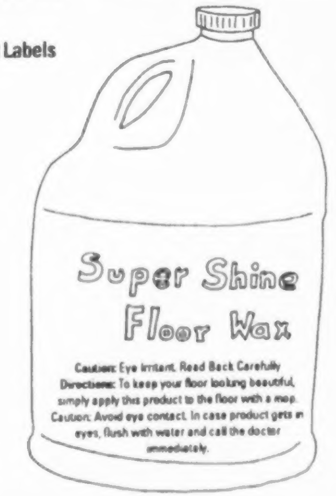
Extensions

- For homework, under adult supervision, have students complete the above questionnaire for two hazardous products found in their homes.

- Attain "Mr. Yuk" stickers from the Vermont Poison Control Center. Ask students to make their homes safer for their younger siblings by placing the stickers on hazardous products.

Hazardous Product Labels


FANCY FINGER NAIL POLISH
Danger: Flammable. Keep out of reach of children.


Super Shine Floor Wax
Caution: Eye Irritant. Read Back Carefully
Directions: To keep your floor looking beautiful, simply apply this product to the floor with a mop.
Caution: Avoid eye contact. In case product gets in eyes, flush with water and call the doctor immediately.

Florida 4Rs

Florida 4Rs Project
Florida Department of Education
Educational Materials
Collins Building Room B1
Tallahassee, FL 32399-0400
(904)487-7900 Melvyn Lord

$4.50

An anthology-type curriculum divided into four grade level packages (preK-3, 4-5, 6-8, 9-12). Each package contains a Florida-specific general introduction, a set of individual lessons and blackline masters, and other student learning materials. 1990.

Preschool-12.

Report Card

General Content	B
Presentation	B+
Pedagogy	B
Teacher Usability	A-
Solid Waste	C+

Comments

Presentation

Transparencies are sharp and attention-getting. Too much print on procedural pages. "Great stuff! Integrated, laid out well, exciting for students." Lessons are well-organized and engaging.

Pedagogy

Doesn't effectively lead learners into proactive conservation behavior. Knowledge is based on hearing, listening to, and reading facts - not enough hands-on. Too many paper-and-pencil activities.

Teacher Usability

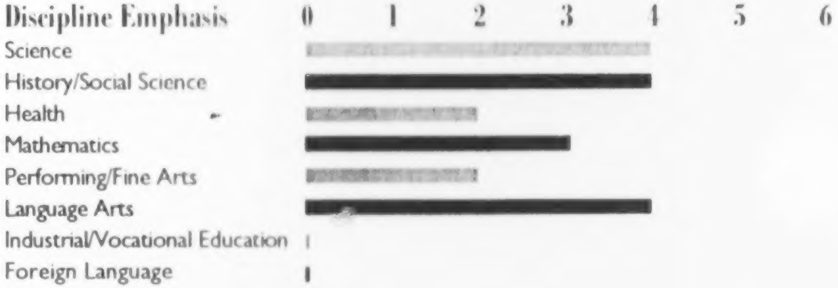
Activities are linked to a conceptual framework. Very "teacher-friendly."

Solid Waste

Does a good job of relating litter abatement to wildlife protection. Household hazardous waste is also included. Scope limited - many issues are not addressed. Fits Florida well, but site issues aren't addressed broadly because of Florida's geography/geology.

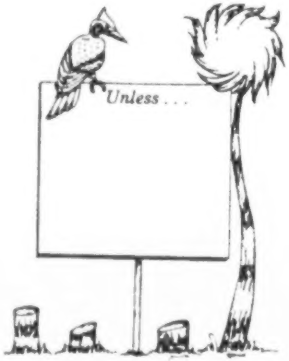
Additional Teacher Thoughts

This is more of a resource book than a complete curriculum.



LESSON OF THE LORAX

Grades: 4-5
Subjects: language arts, social studies, science
Skills: analyzing, reading, listening, writing, communicating, drawing, visualizing, interpreting, inferring, discussing
Group Size: whole class, individual
Setting: classroom or outdoors
DOE Performance Standards: reading A3, C12, C13, C15, C16, D19, D20, D21; writing A5, C23, H62, I70 J76, J80, J81; *A1003, A1004, B1019, B1022, C1036, D1038, E1043, E1044, E1047, E1048, E1049, E1050;* social studies A1, A3, A4, A8, B4, B11, *A1008, A1012, D1059, D1062, D1063, E1088, E1089, F1107, F1108, H1158*; science A32, A35, B44, C98, H250, K280, K281, K282, K283, K284, K285, *A1003, A1060, C1158, 1221, D1223, K1486, K1488, K1491*
4Rs Framework: I.A.1, I.A.2, I.B.1, I.B.3, I.C.1, I.C.2, I.C.3, I.C.4, I.C.5, I.D.1, I.D.2, I.D.3, I.D.4, I.E.1, I.E.2, II.A.1, II.B, II.C, III.B.1, III.B.2, IV.A.1, IV.B.2
Vocabulary: pollution, ecosystem
Time: 60 minutes (or more)



Objectives Students will: (1) make inferences and (2) form conclusions about the environmental impact of human behavior and (3) create an original story ending.

Method Students listen to an environmental fable and answer questions about the impact of an industry on an ecosystem.

Background In THE LORAX, Dr. Seuss introduces the "Once-ler" who cuts down the beautiful Truffula trees so that he can use their wonderful silk tufts to knot "thneeds". Thneed sales are so successful that the Once-ler builds a factory and invents the Super Axe Hacker which cuts down four trees at one time. The Lorax speaks up in defense of the trees, animals, air and water that the Once-ler is destroying in pursuit of bigger and bigger profits. Finally, when the last Truffula tree is cut down, production of thneeds ends. Closed factories, polluted air, polluted water and an uninhabitable wasteland are all that remain on the once beautiful site. The Lorax can no longer live here, but he leaves behind a small pile of rocks on which the word UNLESS is inscribed.

THE LORAX illustrates an ecosystem, a unit in which living and non-living parts interact. All of the parts are linked together and function as a unit. When one of the parts is damaged or removed, the entire system may fail.

Florida has many ecosystems that are suffering. One of the largest is the ecosystem that includes the Kissimmee chain of lakes, Lake Okeechobee, and the Everglades. The original Kissimmee River was dredged and made into a ditch. This ditch carried nutrients into Lake Okeechobee; the filtering action of marshes were by-passed. More and more cattle were introduced into the ecosystem. The nutrient-rich wastes flowed into Lake Okeechobee. These nutrients caused plant blooms. When the plants died, the decay process removed oxygen from the water. This caused fish "kills." Today Lake Okeechobee, the second largest fresh water lake in the United States, continues to suffer from nutrient enrichment. The entire ecosystem may collapse, unless . . .

Materials THE LORAX by Dr. Seuss, *Unless . . .* worksheet (one per student)

Procedure

1. *Classroom Setting:* turn out the lights and tell students to take several deep breaths (breath in for four counts, hold for four counts, breath out for 4 counts). Repeat several times, letting students keep their own count for the last two times. *Outdoors:* find an area away from the playground where students

will be the least distracted. Do deep breathing exercises as described above. Encourage students to become totally relaxed, resting hands on lap with legs comfortably extended or crossed Indian-style.
2. Have students close their eyes as you read THE LORAX. After the story is read, ask students to describe the Truffula tree forest before and after the Once-ler moved in; describe the Once-ler; describe a Bar-ba-loot. Ask students to explain in their own words what the story is about.
3. Read the story again, this time showing the students the illustrations as each page is read. Focus the follow-up discussion on the concept of an ecosystem and note how each step of the Once-ler's developing business removed a piece of the ecosystem until the entire system ceased to function. Encourage students to speculate on: why the Super Axe Hacker was invented; why the Once-ler ignored the Lorax's warnings; what happened to the Lorax; why the Once-ler is called a "Once-ler."
4. Ask students to name some "thneeds" - things that we "think" we need (dolls and toys associated with television characters, "penny" toys at the checkout counter, etc). Ask students how the "thneeds" (things we think we need) are sometimes only "thwants" (things we want), but we get them confused. How do our "thneeds" conflict with protecting the environment. What happens when we want more and more and more? Encourage students to go beyond the simple "create more waste" and to include the negative environmental impacts of the various industries which produce our "thneeds." Ask students to list ways we can control our "thneeds" and live in harmony with the environment.
5. Ask students to explain what happened to the Once-ler when there were no more Truffula trees (manufacturing ended, the factory closed down and all the Once-ler's relatives left; the Once-ler lives alone at the top of his store). What could the Once-ler have done to minimize his factory's effect on the environment (install air pollution and water pollution safeguard devices, replant Truffula trees continuously)?

Evaluation

1. Have students write a paragraph about each of the following issues: why the Once-ler cut down the Truffula trees (the Once-ler uses the Truffula tufts to make Thneeds); why the Brown Bar-ba-loots have to leave (Truffula fruit, their main food, becomes scarce when Truffula trees are cut down; Bar-ba-loots get *crummy tummies* from hunger); what the Lorax's message "Unless" means (answers will vary, but students should mention the need for future generations to care for the earth).
2. Have students list three ways the Thneed factory caused problems for the Truffula Tree forest and its residents (created smog, polluted pond, cut down trees, forced wildlife relocation).
3. Distribute worksheet *Unless . . .* to students and have them write a new conclusion for THE LORAX following where the word "*Unless . . .*" leaves off.

More

1. Have students research a similar issue that has been or is currently in the newspaper. Have each explain to the class how the issue is similar to the story of THE LORAX, and how it is different.
2. Have students create a collage of thneeds (things we think we need), either as a class project or individually, by cutting pictures from magazines.
3. Discuss the ways we use natural resources, emphasizing their value in our lives. Have students create ads for natural resources, modeled after the Once-ler's Ad for the Thneed:

"A Thneed's a Fine-Something-That-All-People-Need.
It's a shirt. It's a sock. It's a glove. It's a hat.
But it has other uses. Yes, far beyond that.
You can use it for carpets. For pillows! For sheets!
Or curtains! Or covers for bicycle seats."

4. Instruct students to draw diagrams or flow charts of the steps involved in the production cycle of thneeds.
5. Have students illustrate their needs and wants as contrasting pictures, "Thneeds" and "Thwants."
6. Plant a tree!

Action THE LORAX spoke for trees "for the trees have no tongues." Have students choose one thing to speak for, decide what they would say and then speak for one minute on behalf of their thing which cannot speak for itself.

Garbage Reincarnation

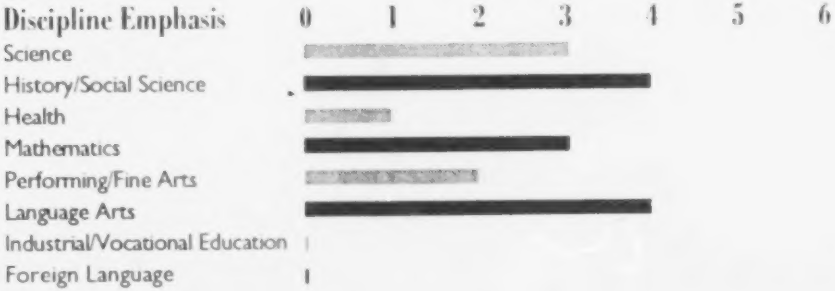
Garbage Reincarnation
Sonoma County
Community Recycling
P.O. Box 1375
Santa Rosa, CA 95402
(707) 584-8666 Linda Christopher

Call for cost
information.

This Instructional Aids Packet is divided into four sections related to materials conservation and solid waste management. The four sections are: Solid Waste, Everything Goes Somewhere, Recycling in the Classroom and the Home, and Community Involvement. 51 pages. Updated version to be released in December 1993.

Grades K-6.

Report Card	
General Content	A-
Presentation	B
Pedagogy	B+
Teacher Usability	B
Solid Waste	C+



Comments

General Content

Some artificial integration of disciplines. A fun curriculum with some original ideas. Engaging narrative woven throughout curriculum.

Presentation

Printed on 100% recycled-content, unbleached paper. "Looks artsy and homemade." Some activities and charts are not developmentally appropriate. The activities do not include prepared materials for student use.

Pedagogy

Misses opportunities for students to explore their own waste management practices. No evaluation is provided.

Teacher Usability

Uses durable cardstock for each page. Teacher resource list is somewhat outdated but includes videos. Pages are crowded and busy, sometimes making it difficult to read. This is a very abbreviated curriculum, and requires a good deal of "teacher as researcher into information available" time. Teacher and student worksheets are the same.

Solid Waste

"Teaches worm composting - many curricula fail to mention this natural and age-old approach to recycling organic waste." Because it is an older curriculum, it lacks the current emphasis on purchasing recycled goods; however, it does a good job explaining and demonstrating "3Rs" (Reduce, Reuse, Recycle).

Additional Teacher Thoughts

"Lessons have a loving, folksy spirit to them. Very sincere, effectively designed lessons that have been teacher-tested for sure success in the classroom."

"A quite nice small curriculum. I was surprised."

Preparation: Minimal. Some materials needed.

Class Time: 1hr. the first day, 10 to 15 minutes a day thereafter until complete (approx. 10 days)

Subject Area: Science.

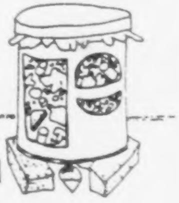
Objective: To see how a sanitary landfill is made.

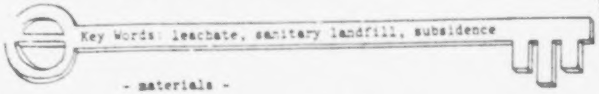
MAKING YOUR OWN MINI LANDFILL

Making a small scale replica of a *sanitary landfill* will give you a better understanding of what a *sanitary landfill* is and how it's made. You will experience some of the problems that must be dealt with by *landfill* operators when you see *subsidence* taking place and *leachate* being created right in your own *mini landfill*.

things to think about...

... how would you design a *landfill* site?
... what are some possible hazards that might result from improperly designed *landfill* sites?



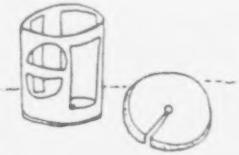


Key Words: leachate, sanitary landfill, subsidence

- materials -

- One 5 gallon ice cream container and two lids (you can get these from your local ice cream parlor).
- One used, clear plastic bag large enough to fit in the ice cream container.
- 3 bricks (or something similar in size).

Activity #5

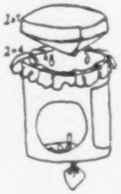


1) Use a 5 gallon ice cream container with a lid.

2) Cut large circles, squares, and triangles (about 4 or 5) out of the container.

3) Make one straight cut in the lid from the rim to the center.

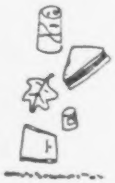
4) Cut a 1/2 inch hole in the center of the lid and another in the center of the bottom of the ice cream container.



5) Fold the ice cream container top together so the ends overlap and put it down into the bottom of the carton.

6) Pull a corner of the plastic bag out through the two holes (one in the top and one in the bottom of the container) 8 to 10 inches. This will act as a reservoir for the *leachate* to collect in.

7) Fill the container daily with layers of scraps from your lunches, leaves from the school yard, paper, and anything else you think might go into a *landfill*. Don't forget glass, aluminum, steel, bi-metal, plastic, and maybe some oil. This is a mini *landfill* so only use small pieces. The material should be put in at a ratio of 4 parts waste to 1 part dirt. A good rule to follow would be 1 inch of waste covered by 1/4 inch dirt. Remember to always cover the waste with dirt and pack it down lightly. A small amount of water should be sprinkled on your *landfill* after each layer of waste and dirt is put down.

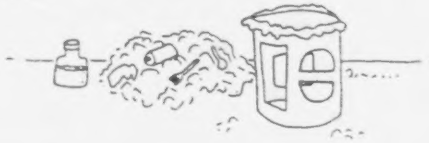


8) Fill the mini *landfill* 1/2 to 3/4 full. Place it on 3 bricks (or something similar) so there will be space under the container for the corner of the plastic bag to fill with *leachate*.

9) Water the mini *landfill* on occasion as though it were raining over it. Don't overwater. Try to reproduce the conditions that exist for a real *landfill*. Each time you water it, look for *subsidence*.

10) After the mini *landfill* is complete, use the second top to cover the container and let it sit for at least 2 months.

11) After the two months have passed, collect the *leachate* that ended up in the corner of the plastic bag. What do you think of it? Empty the contents of the mini *landfill* to see which items decomposed and which didn't.



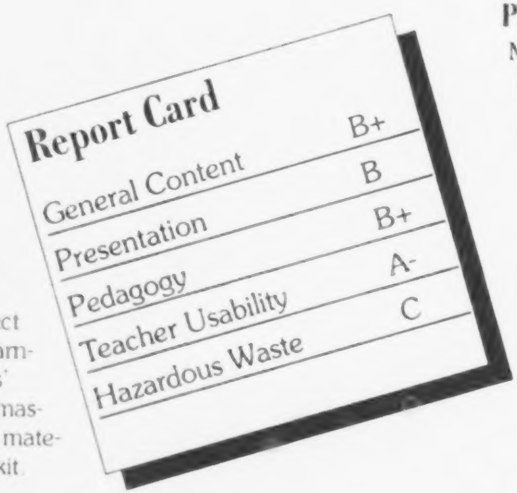
CHEM
(Chemicals, Health, Environment, and Me)

SEPUP (Science Education for Public Understanding Program)
Lawrence Hall of Science,
U. C. Berkeley
1 Centennial Drive
Berkeley, CA 94720
(510) 642-8718

$125 (Materials for 160 students).

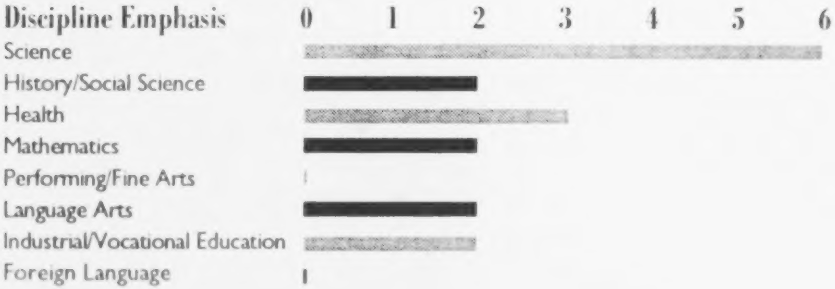
Ten chemistry-based units utilizing commonly available household and classroom supplies, with the emphasis on direct experience by the learner. Includes teachers' guide with blackline masters, and a complete materials and equipment kit. 129 pages, 1993.

Grades 5-6



Report Card

General Content	B+
Presentation	B
Pedagogy	B+
Teacher Usability	A-
Hazardous Waste	C



Comments

General Content

Chemistry lessons build sequentially through chemical understanding to knowledge of hazardous waste. Other disciplines are integrated through the use of extension projects.

Presentation

Material is difficult and demanding and may be more suited for advanced 5th and 6th graders.

Pedagogy

Students are actively engaged in constructing knowledge.

Teacher Usability

Good stand-alone resource to draw from. Materials and disposables must be purchased, and setup and cleanup is intensive, but worth the effort.

Hazardous Waste

While this is a very complete chemical education curriculum, it does not attempt to comprehensively cover all hazardous waste issues.

Additional Teacher Thoughts

"Possesses strong focus in the science of chemicals, which can be used as a knowledge and skills platform for future, more specific labs/lessons in household and industrial hazardous materials. This is a science activity first, an environmental activity second."

Date Name

Procedure

1. You are going have lunch on a field trip. Write down your lunch menu.
2. For each menu item, record trash information in the next two columns.

Activity Two
Part One

Purpose
You will explore the amount of trash we each produce when we pack a lunch.

Materials
No additional materials are needed.

Individual Field Trip Lunch

Menu Item	Trash	Number of Trash Items
	Total Number of Items	

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Date Name

Procedure

1. Record the sum of the trash items for your four individual lunches (Part One).
2. Plan a group menu substituting items that produce less trash. Total the number of items of trash produced by your group menu and compare the total the total in Step 1.

Activity Two
Part Two

Purpose
You will reduce the amount of trash we each contribute by planning a lunch for the group emphasizing source reduction. You will identify which items of trash can be recycled or reused.

Materials
No additional materials are needed.

Group Field Trip Lunch

Menu Item	Trash	Number of Items	Recycled	Reused
	Total Number of Items			

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RAYS

RAYS
"Recycle And You Save"

San Diego County Division
of Solid Waste
5555 Overland Avenue
Mail Stop 0383
San Diego, CA 92123
(619) 974-2648 Carol Gann

$15

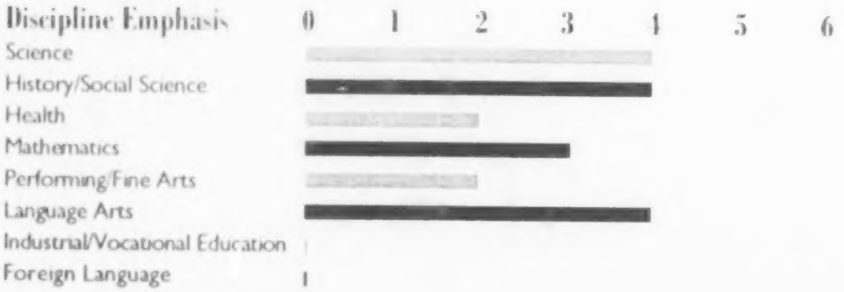
A collection of activities correlated to the California State frameworks for Science, Social Science, Mathematics, Language Arts, and Health. Designed to be easily integrated into daily teaching plans. Divided into grade level sections of K-2, 3-4, and 5-6. 71 pages, plus appendices, 1991

Grades K-6

Report Card

General Content	B
Presentation	B-
Pedagogy	B
Teacher Usability	B+
Solid Waste	C+

Discipline Emphasis



Comments

General Content

Good integration of math as applied to solid waste concepts. Provides listings of related activities. The scope is limited, but presented well.

Presentation

"Didn't take the opportunity to do double-sided copying - actions have to match words." Curriculum is printed on recycled paper. Some activities are not developmentally appropriate; much stronger at K-2 than at this level.

Pedagogy

"Finally! One that defines (clearly) how it addresses cultural issues."

Teacher Usability

Many facts and resources are regionally (San Diego) based so a teacher would have to supplement with local information. It would be nice to have tabbed divisions at each section, including a list of concepts covered. Book layout/contents page is confusing, making lessons difficult to locate quickly. Good resource guide and appendix. Good management tips and extensions for each lesson. Lessons don't list the needed worksheets.

Solid Waste

Very strong on recycling.

Additional Teacher Thoughts

Allows students to develop a broad knowledge base in resource use and energy conservation. "I like the way literature is used to introduce units."

LESSON THREE

REFUSE: EVERYONE'S CONCERN

Waste—The Case for Reduction

LESSON SUMMARY

Students will collect refuse (with parental consent) to create a bulletin board. They will also discuss alternative packaging, refuse, and landfill problems.

Age	Grades 5–6
Subjects	Science, Social science, History
Duration	Seven 20-minute days or five 25-minute daysplus 15 minutes for discussion
Group size	30
Setting	Indoors
County goal	Waste Reduction
Vocabulary	sanitary landfill, biodegradable/biodegradability, natural resource, deforestation, environment, solid waste, solid waste management

LEARNING OBJECTIVE

Students will be able to identify three ways that individuals can use to reduce the amount of refuse the family produces; and list three problems resulting from waste generation (landfill overload, pollution of air, water, and land).

MATERIALS

-Blackline masters titled "Growth of Trash" (Work Sheet 10), "Don't Throw Your Trees Away" (Work Sheet 11), and "The Great Trash Story" (Work Sheet 12)

-Parent letter example (Work Sheet 13)

-"Sort the Trash" (Work Sheet 14)

-Bulletin board materials (butcher and construction paper, letter stencils, scissors, staplers, markers)

-Calculators

-Pictures of forests, mountains, beaches, oil refineries

-Samples of paper, metal, glass, plastic

BACKGROUND INFORMATION

Over 4 million tons of solid waste are generated in San Diego County each year. That is enough to fill Jack Murphy Stadium every two weeks. Currently, less than 20 percent of the region's solid waste is recycled. If this trend continues—throw it away rather than recycle it—our landfills will reach capacity by July 1, 2001! It will cost taxpayers $2.5 million to search for and create a new landfill.

As 5 percent of the world's population, the United States creates 30 percent of the world's trash.

California's number one export is used paper. The paper is shipped thousands of miles by container ship to paper mills in the Philippines and Japan, among others. This means that trees, one of our vital natural resources, are cut down, processed into paper, and leave our shores, never to be reused or returned to our soil. Every minute, 100 acres of the world's forests, which took hundreds of years to grow, are cut down. The consequences of this are felt everywhere: oxygen, produced by plants, is drastically reduced, thereby rendering our already polluted air more hazardous; hundreds of species of plants and animals become extinct; according to scientists, forests keep the Earth cool—planetary warming

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How Glass Is Made—II

Objective: To gather more information about glass

Subject Areas: History, science, reading, art

Materials Needed: A film on modern glassmaking from the library

Procedure–Activity: 1. Research the history of glassmaking at the library. Selected students can give a brief oral report. It might be valuable to have students pick separate historical periods and/or countries and report on the particular method used.

2. Show a film of a modern glassmaking factory. After the film, ask the students questions:

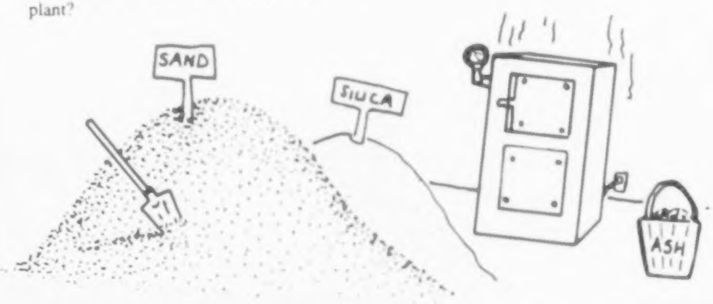
Do they use glass containers? If so, why? If not, why not?

Would they like to work in a glass factory? Why or why not?

What are the benefits of recycling for a glass plant?

3. Discuss the resources needed to make glass and where these resources come from (sand, silica, potash, and energy—oil, gas, electricity).

Resources: Have a glass recycler come to your class and talk to you about modern glassmaking techniques.
Suggestion: Seek assistance from California Glass Recycling Corporation. They are headquartered at 5709 Marconi Avenue, Suite C, Carmichael, CA 95608. Tel: (916)483-8475.



Super Saver Investigators

Super Saver Investigators
Ohio Department of Natural Resources
Division of Litter Prevention and Recycling
Educational Specialists: SSI
Fountain Square, Building F-2
Columbus, OH 43224
(614) 265-633

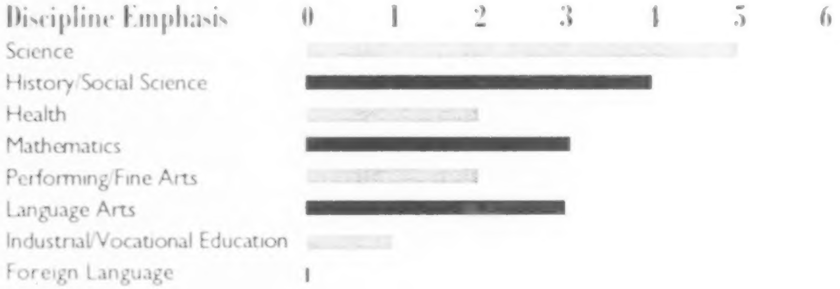
$25 check or money order, single orders only.

An elementary, interdisciplinary, environmental studies activity guidebook about solid waste and natural resources that contains many hands-on, skill-enhancing activities. The ideas for these activities were generated at a week-long workshop by a group of Ohio elementary teachers actively involved in environmental studies education. 384 pages, 1990.

Grades K-6

Report Card

General Content	B-
Presentation	C+
Pedagogy	B-
Teacher Usability	B
Solid Waste	B-
Hazardous Waste	C+



Comments

General Content

Many of the curriculum connections are very artificial, especially in language arts. Does not really involve students in "real-life" situations.

Presentation

Very "eye-friendly" text. Includes some pencil-and-paper activities that are developmentally inappropriate, although some may be good for LEP (Limited English Proficient). Activities do not specify grade level, only "primary" or "intermediate."

Pedagogy

Some good investigations, but you need to search for them. "Intentions are good, but a great deal of knowledge dealing with recycling and hazardous wastes is not gleaned through activities, but through teacher background notes." "Experiments" tend to be teacher demonstrations.

Teacher Usability

Provides a wealth of useful background information on each topic. Useful indices for locating topics. Multiple class periods are sometimes required for one lesson, with no indication of how to divide the time.

Solid Waste

Does a good job of teaching composting. Heavy emphasis on litter; not well-balanced overall.

Hazardous Waste

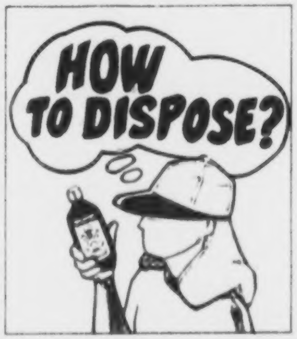
Emphasis is on household hazardous waste; business and industry hazardous wastes are not addressed.

Additional Teacher Thoughts

"Reaffirms the value of a clean, litter-free environment kept that way by the people who live in it or visit it." "Seemed to me to be difficult to use generally. I think because there was so much."

HAZARDS AND WASTE

CHAPTER 8


HOW TO DISPOSE?

INTERMEDIATE

Objectives Students will be able to: (1) *describe* what makes some household products hazardous, (2) explain the importance of warning labels on products, (3) *classify* household hazardous products by use, (4) identify methods of disposing of household hazardous products and containers when no longer needed and *explain* how improper disposal can pollute the environment and water supply. Students will improve their ability to *make inferences*.

Method Students make adjectives out of nouns and verbs to describe the characteristics of household hazardous products. They identify hazardous products in their homes and read labels with the help of adults in order to classify household hazardous products. Students make inferences from an illustrated map to answer questions about the effects hazardous product disposal can have on the environment. They create their own labels for hazardous products.

Duration: five to six class periods

Setting: classroom, home

Subjects: Science, Language Arts

Curriculum Reference: 4.1, 4.2

Preparation writing materials, dictionaries, some samples of household hazardous waste products with warning labels (Find an item from each household category identified in the Background Information, p. 200)

Vocabulary aquifer, brand name, corrosive, environment, generic name, hazardous, household, ignitable, incinerator, open dump, pollution, reactive, sewage treatment plant, synonym, toxic, warning, water purification facility

Handouts ***Describing Harmful Waste; Identifying Household Hazardous Products; Hazardous Waste Disposal Routes; Warning Labels***

Procedures

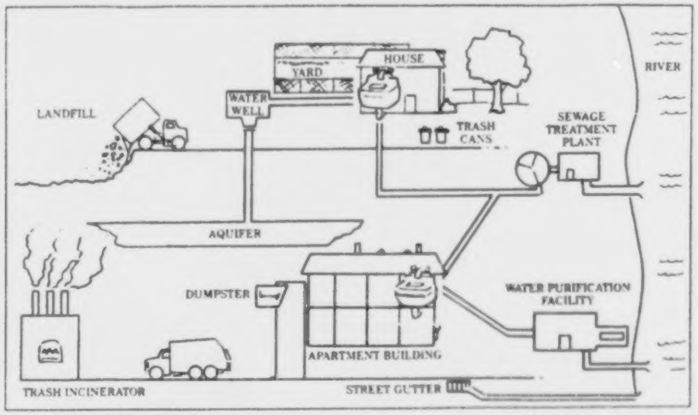
1. Have students complete the handout, ***Describing Harmful Waste***, to become familiar with the traits of hazardous products which often become part of the waste stream.
2. After completing the handout explain the following descriptions of hazardous waste to students. You may wish to write these on the board.
   a. Hazardous waste poses a danger to human health and to the environment because of one or more of the following characteristics which a hazardous substance may possess. It may be

      ignitable
      corrosive
      reactive
      toxic

   b. A hazardous waste may take the form of a solid, a semi-solid, a liquid or a gas.
   c. Many items that we throw away in our homes contain hazardous substances. We call them *household hazardous waste*.
3. Refer to the list of household hazardous products in the Background Information of this chapter, p. 200. Find a sample item from each "household category" to bring in to class to discuss with students. Try to find products with warning labels. But, be aware, the hazardous nature of many household hazardous products is unknown, or not clearly identified or not often discussed on the warning label. Some products will say "flammable" or "ignitable" on the label when they are actually "reactive" and per

[illegible]

HAZARDOUS WASTE DISPOSAL ROUTES



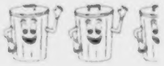
Directions: Look at the diagram above to help you answer the questions below. Answer questions on a separate sheet of paper.

1. Name two places where waste materials, including household hazardous waste, are often taken when you throw them away in your trash can or dumpster.
2. What can happen to the environment if wastes are not disposed of properly in these two places? How can waste be disposed of properly in these two places so that pollution is contained?
3. Name two ways that the river in the diagram could become polluted by household hazardous waste.
4. Many people get their drinking water from underground aquifers. Describe two ways an aquifer could become polluted. What affect might this have on people living in the house in the diagram?
5. Many people get their drinking water from rivers. Describe how polluted water could get into the drinking water at the apartment.

Trash Today, Treasure Tomorrow

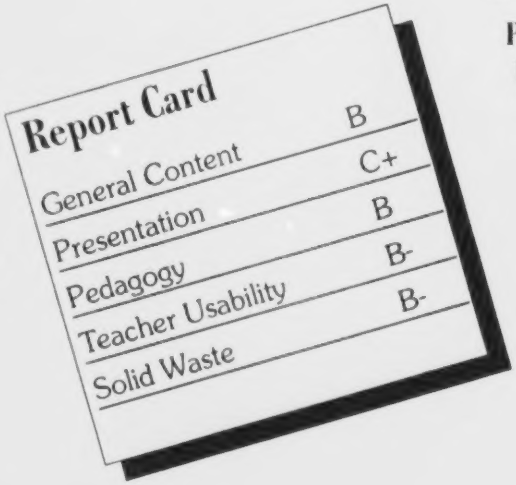
Trash Today, Treasure Tomorrow
Developed by: University of
New Hampshire Cooperative Extension
Distributed by: Governor's Recycling Program
Office of State Planning
2 1/2 Beacon Street
Concord, NH 03301
(603) 271-109

$12.50.

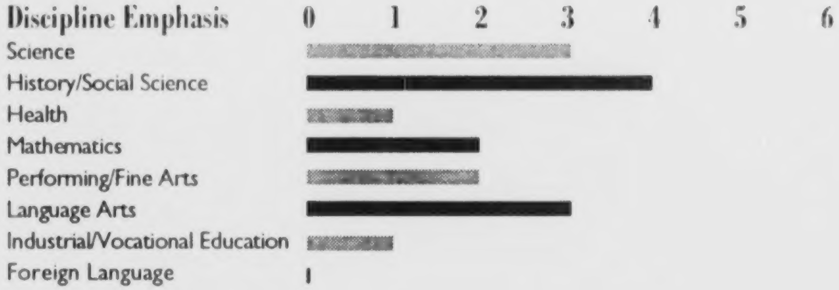


A collection of activities adapted from existing sources. Divided into 5 sections: Kindergarten Readiness; 1-2, 3-4, 5-6, and General Information. 1989.

Grades 4-6.



Report Card	
General Content	B
Presentation	C+
Pedagogy	B
Teacher Usability	B-
Solid Waste	B-



Comments

General Content

Concepts do not build sequentially, nor do activities. "3-4 and 5-6 activities identical - redundancy equals poor ecology." Could use more background information and allow students to go deeper into subjects covered. Integrates more math in grades 5-6.

Presentation

Limited English students could easily participate in many activities. Gives students regional environmental awareness - a sense of "being at home." Printed on both sides of recycled paper. Page layout too spread out for the eye to read easily. Science inquiries are often not age-appropriate.

Pedagogy

Plenty of activities to do to keep kids busy. Too teacher-directed - many lessons say "Teacher will explain."

Teacher Usability

It lacks page numbers for handy referencing. No resources and no table of contents. No obvious attempt to group lessons in any order.

Solid Waste

Emphasized the need for students and their families to create market demand for recycled goods. Includes some household hazardous waste information.

Additional Teacher Thoughts

Some great crafts projects: quilts, reusable grocery bags, etc.

ACTIVITY SHEET

Where From, Where To?

OBJECTIVE: Students will trace objects from their source, to the consumer, and back again.

BACKGROUND: Everything we make, use and throw away comes from and returns to the earth.

ACTIVITY:

1. Ask each student to bring to class a common household object made from only one material (e.g. rubber eraser, glass jar, piece of paper, plastic bag). Each student will identify the natural resources used and the steps taken to make the object and deliver it to the consumer. Then trace all the steps needed to recycle the product back into another object. Illustrate the life cycle.

2. Discuss the different steps required to produce the things we use each day. How many times is the object transported in its life time? By what? Using what as fuel? Is the object easily reusable? Is it easily recyclable? What are the environmental effects of producing and transporting the object?

3. Trace the life cycle of a pencil or other commonly used, inexpensive object made from several different resources. Is a pencil easily recyclable?

4. Roleplay the life cycles of different objects (e.g. one recycled vs. one landfilled; styrofoam vs. paper, etc.)

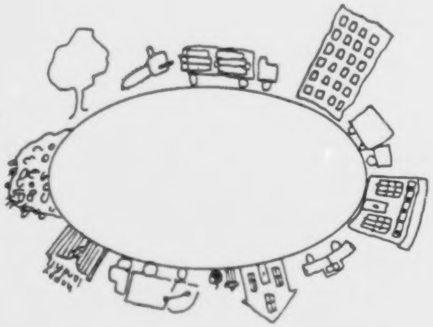
MATERIALS NEEDED: One object made of one material per student.

LENGTH: One class period.

EVALUATION: Students should be able to trace the life cycle of any object made from one material. How many steps or phases are there in the lifecycle of your object?

UNIVERSITY OF NEW HAMPSHIRE
COOPERATIVE EXTENSION
Helping You Put Knowledge And Research To Work

tree
logger cuts
trucker hauls
processed in mill
furniture factory buys wood
trucker hauls
factory processes into candlesticks
trucker hauls
wholesale store buys
trucker hauls
retail store buys
transports
customer buys and uses
transports
thrift store
transports
discarded in landfill
decays into contaminated soil



Lifecycle Of: ______________________

Household Toxics

Household Toxics
San Diego Regional Household
Hazardous Materials Program
P.O. Box 85261
San Diego, CA 92186-5261
Attn: Pam Jackson
(619) 338-2175

$15.

Promotes the safe use, storage, and disposal of household toxics, and the use of safer alternatives. Materials include a video, lesson plans, teachers' guide, and reference materials. Some materials available in Spanish. 1988, 141 pages.

Grades 4-6.

Report Card

General Content	C+
Presentation	C
Pedagogy	C-
Teacher Usability	B
Hazardous Waste	B-

Comments

General Content

"Defining science vocabulary words is not science." Would be good for teaching (household hazardous waste) survival skills to children and new immigrants.

Presentation

Lessons are accessible to LEP (Limited English Proficient) students.

Pedagogy

Science activities are teacher demonstrations; they could be student explorations. More emphasis is put on knowledge than on application. Lots of paper-and-pencil activities (word searches and crossword puzzles).

Teacher Usability

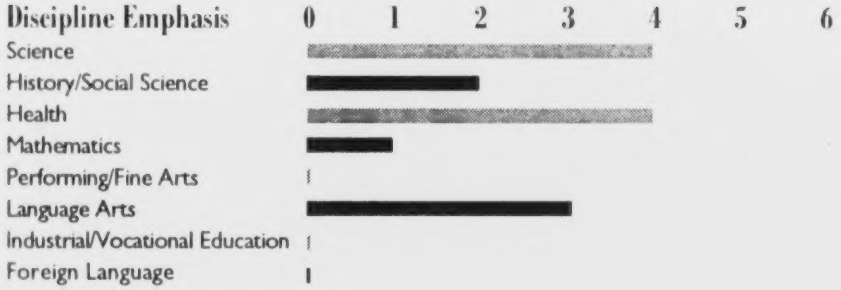
Technically accurate background facts. Uses video for several units, helps to "set the hook" at the beginning.

Hazardous Waste

Very narrow in scope - only addresses household hazardous waste.

Additional Teacher Thoughts

A community-based curriculum. Specific San Diego locations are given where students can recycle toxics.



101

102

☆WASTE DISPOSAL ROUTES
Activity 2

Purpose: To trace what happens to household toxics if they are thrown in the garbage or poured down the storm drains or sewer in San Diego County, and to make it as personal as possible for the students.
Approximate time: 20 minutes
Method of presentation: Examining map on Activity Sheet #1a or #1b (#1a covers the southern portion of San Diego County, #1b covers the northern portion of the county). A home learning activity should be incorporated into this activity - see notes below.
Skill or learning process: Map reading, information gathering
You will need: An overhead of Activity Sheet #1a or #1b depending on where your school is located; an overhead projector; other maps of your area showing more detail could be helpful.
Home learning activity: Before examining the map, have students find out who picks up their garbage and where it goes. The garbage could be picked up by either public or private waste haulers and taken to one of the four landfills in the county. To find out about County landfills, students can call 694-2178; for the City of San Diego they can call 573-1745. The should also find out the source of their drinking water (call the San Diego County Water Authority at 297-3218) and what happens to their waste water when it goes down the drain (look in the Government Pages of the Telephone Book White Pages under "Utilities").

As the video indicated, the improper disposal of some household products can pollute our environment, especially our ground and surface waters. Household toxics become hazardous waste when it is time to get rid of leftovers. Another word for hazardous waste is toxic waste.

Ask students what they know about toxic waste -- they may have studied this earlier.

Ask students how they get rid of leftover food scraps in their home. Possible student responses:

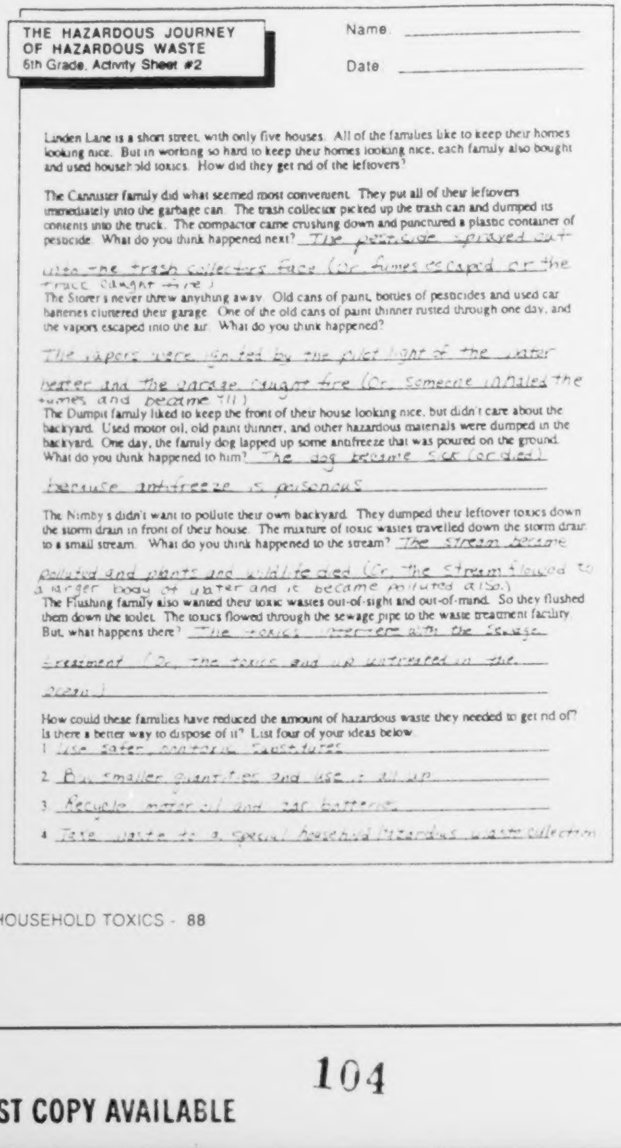
1. They throw them in the trash for the garbage collector to pick up.
2. They put them in the garbage disposal.
3. They throw them into a compost pile in the back yard.

Ask students what then happens to the food scraps.

> In all three cases, the food will eventually decay, breaking down to simpler compounds. If the food is put into the garbage disposal, this will happen quickly because the sewage is treated to make it decay.

Ask students if these disposal options work for household toxics.

Teacher's Guide to Activity Sheet #2



THE HAZARDOUS JOURNEY OF HAZARDOUS WASTE
6th Grade, Activity Sheet #2

Name ____________________

Date ____________________

Linden Lane is a short street, with only five houses. All of the families like to keep their homes looking nice. But in working so hard to keep their homes looking nice, each family also bought and used household toxics. How did they get rid of the leftovers?

The Cannister family did what seemed most convenient. They put all of their leftovers immediately into the garbage can. The trash collector picked up the trash can and dumped its contents into the truck. The compactor came crushing down and punctured a plastic container of pesticide. What do you think happened next? The pesticide sprayed out into the trash collectors face (Or, fumes escaped or the truck caught fire.)

The Storer's never threw anything away. Old cans of paint, bottles of pesticides and used car batteries cluttered their garage. One of the old cans of paint thinner rusted through one day, and the vapors escaped into the air. What do you think happened?

The vapors were ignited by the pilot light of the water heater and the garage caught fire (Or, Someone inhaled the fumes and became ill.)

The Dumpit family liked to keep the front of their house looking nice, but didn't care about the backyard. Used motor oil, old paint thinner, and other hazardous materials were dumped in the backyard. One day, the family dog lapped up some antifreeze that was poured on the ground. What do you think happened to him? The dog became sick (or died) because antifreeze is poisonous

The Nimby's didn't want to pollute their own backyard. They dumped their leftover toxics down the storm drain in front of their house. The mixture of toxic wastes travelled down the storm drain to a small stream. What do you think happened to the stream? The stream became polluted and plants and wildlife died (Or, the stream flowed to a larger body of water and it became polluted also.)

The Flushing family also wanted their toxic wastes out-of-sight and out-of-mind. So they flushed them down the toilet. The toxics flowed through the sewage pipe to the waste treatment facility. But, what happens there? The toxics interfere with the sewage treatment (Or, the toxics end up untreated in the ocean.)

How could these families have reduced the amount of hazardous waste they needed to get rid of? Is there a better way to dispose of it? List four of your ideas below.

1. Use safer, nontoxic substitutes
2. Buy smaller quantities and use it all up
3. Recycle motor oil and car batteries
4. Take waste to a special household hazardous waste collection

Toxics In My Home? You Bet!

Toxics In My Home? You Bet!
Developed by: Golden Empire
Health Planning Center
Distributed by:
Local Government Commission
909 12th Street, Suite 305
Sacramento, CA 95814
(916) 448-1198

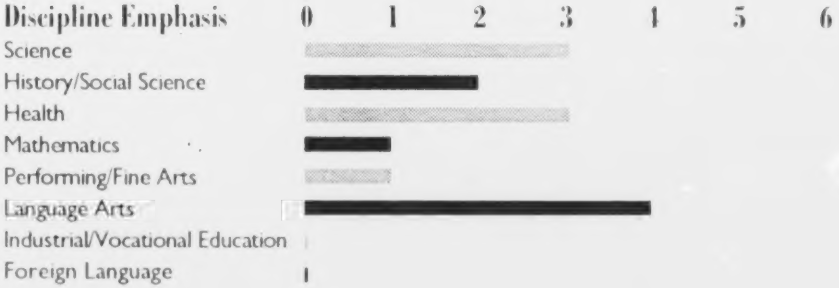
$12, or $16 with binder.

Consists of a one-week course of study designed to educate students about toxic substances commonly found in the home. Lessons may also be used individually. Materials available in Spanish. 50 pages plus appendices, 1984.

Grades 4-6.

Report Card	
General Content	B
Presentation	B-
Pedagogy	C
Teacher Usability	B-
Hazardous Waste	B-

Discipline Emphasis



Comments:

General Content

Simplistic. Not enough science activities.

Presentation

Thorough, factual, and engaging. Deals with personal as well as environmental effects. Type is difficult to read. Would be more suited to grades 2-3.

Pedagogy

Not enough constructivist activities; relies a lot on teacher downloading information to reach understanding of concepts and objectives. Good situation-analysis activities; open-ended. Some paper/pencil activities.

Teacher Usability

Good set of appendices for each set of materials which explains how to dispose of or reuse substances. Good resource list and teacher information.

Hazardous Waste

Limited in scope. Covers the disposal of wastes pretty well.

Additional Teacher Thoughts

"I like the page that had the visual food and candy look-alikes that could be confused with common household hazardous materials." The Spanish version would be good for new immigrants' safety and health education (adult or child).

CONCEPT IV

PURPOSE:

To create an awareness that safe substitutes are available for many household toxics.

OBJECTIVE:

Students will identify safe substitutes for some toxic products and where they can be obtained.

MATERIALS:

1. Advertisements from magazines and newspapers showing toxic products.
2. 4 x 4 grids, one for each student (to be used as bingo cards, page 47).
3. A price list of common household toxics and substitutes. This is optional. If teacher chooses to use this activity, she/he must develop a current price list for "household toxicants" and for their safer substitutes. (Use "Safer Alternatives for Toxic Products", pages 49-50 for product ideas.)
4. A list of alternatives for toxic products (pages 49-50, one for each student).
5. "Master" cards, to be cut up and put in a box or can, page 48.
6. Beans or small pieces of paper to be used as markers - 10 for each student.
7. Chalkboard/chalk/eraser.
8. Optional: Samples of substitute products (e.g., flowers, sachets, herbs, pump spray, washing soda, vinegar, baking soda, vegetable oil, etc.).

TIME: 40 minutes.

TEACHING PROCEDURES:

1. Introduce the lesson by asking students to name some potentially toxic products used in their homes to: a) clean and freshen the house; and b) take care of the yard and garden. List their responses on the board under the "a" and "b" categories identified above. Add some of your own.

Flea Repellant

- Place eucalyptus seeds and leaves around the area where the animal sleeps.

Floor Cleaners

- Use soap and water.
- Use washing soda and water.

Furniture Polish

- Use a soft cloth and mayonnaise.
- Mix 1 part lemon juice and 2 parts vegetable oil.

General Cleaners (All Purpose Cleaner)

- Mix 3 TBSP. washing soda in one quart of warm water.
- Use baking soda with a small amount of water.

Glass and Window Cleaners

- Use cornstarch and water.
- Mix 1/2 cup vinegar and one quart warm water. Wipe with newspapers.
- Use lemon juice and dry with a soft cloth.

Oven Cleaners

- Mix 3 TBSP. of washing soda with one quart of warm water.
- Place liners in oven to catch any drips during baking.
- Sprinkle salt on spills when they are warm and then scrub.
- Rub spills gently with steel wool.

Paint

- Water based paints are less toxic than metal based. After using them, no solvent is necessary for "clean up".

Rat Poison

- Put a screen over drains.
- Use mechanical-snap mouse traps.

Scouring Powder

- Dip a damp cloth in baking soda and rub.
- Use steel wool.

Snail/Slug Bait

- Place a shallow pan with beer in the infested area.
- Overturn claypots. The snails will take shelter in them during the sunny days and they can be collected and removed.

Waste Is a Terrible Thing To Waste

Waste is a Terrible Thing to Waste
Exegetics Interpretative and Educational Services
P.O. Box 191895
Sacramento, CA 95819-7895
(916) 381-7795

$35 plus tax

A collection of classroom activities for grades K-6, ranging from simple worksheets to difficult socio-dramas. This collection was written at the request of the Sacramento County, California, Solid Waste Management Division. 118 pages, 1991.

Grades K-6

Report Card

General Content	B-
Presentation	B
Pedagogy	B-
Teacher Usability	B-
Solid Waste	C+

Comments

General Content

Difficult to see continuum; unifying themes not readily apparent. Could have had more science lessons, however does include integrated math activities.

Presentation

Professionally typeset, using recycled paper. Vocabulary is defined in terse, general terms. Good emphasis on community awareness, personal choices, and responsibility. Students are taught to value and to make choices based on their values.

Pedagogy

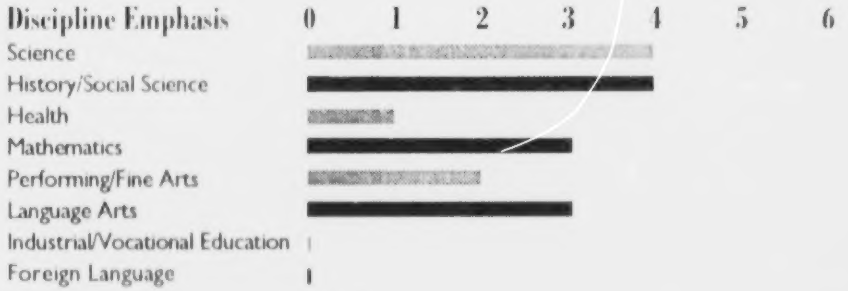
Student-directed inquiry provides opportunity for higher-level thinking and interesting learning experiences. Cooperative group strategies used.

Teacher Usability

Good teacher background in front.

Solid Waste

There seems to be an undue emphasis on the amount of trash we generate at the expense of other vital solid waste issues.



Should I Eat the Food or Just the Box?

Objectives

Students will: 1) analyze the types of materials used to package food; 2) calculate the caloric content of the food and that of the packaging materials; 3) suggest alternative packaging methods.

Grades: 5 - 6

Method

Students examine several products they buy, compare the volume of product to the volume of packaging and compare the caloric energy of the food with that of the package.

Materials

package of food for each group
several scales (triple beam, kitchen, or postage scale)
containers to pour package contents into
writing materials
worksheets, several per group (included)

Procedure

Encourage students to bring in a package of food. You may want to have a few extra for students who forget.

Assign students to work in groups of two to four. Have them complete a worksheet for each package of food they have brought in.

Distribute worksheets.

Each group will not need its own scale, but there should be at least one for every three groups of students.

Extension

Discuss "generic" packaging. These are packages that are plainly wrapped and labeled with the contents. They lack the pretty pictures and descriptions of the products, and only list the name and ingredients. Ask students to identify some of the advantages and disadvantages to generic products. *(They are generally much cheaper than a name brand, but the quality can be inconsistent.)*

Identify common items students buy and their prices. Have them figure out the cost without the package. *(Approximately 10% of the price paid for an item goes to the package.)*

Notes and Comments

Should I Eat the Food or Just the Box?

When you think of food, what types of things come into your head? If you are like most people, you think of something in a package. More and more food is being packed in more and more packages. Currently, about 30% of our waste is packaging materials. When you buy a product, up to10% of the price you pay is for the package that you are going to throw away!

A calorie is a unit of energy. It takes calories to do work. We get our calories from food and that allows us to do work and play. It also takes calories to make boxes, cans, and even toys.

Use the package of food you have to answer the following questions.

How many calories are in the food itself? (this should be listed on the side of the container. Remember to multiply calories per servings by the number of servings per container). ____________

Remove and save all the packaging.

List each piece of packaging.				
Of what is it made?				
How much does it weigh? (in grams)				
Is it recyclable?				
Is it from a renewable or non-renewable resource?				
What is its purpose?				
Use Chart One to determine the amount of calories in this piece of packaging				

Add up the calories for all the packaging materials. ____________

Which has more calories in it, the food or the package. ____________

Can you redesign the package to be more efficient? Draw your idea on the back of this page.

Chart 1
Energy Used By Packaging Materials[1]

paper:	1 gm = 11.3 calories	1 oz = 320 calories
glass:	1 gm = 4.2 calories	1 oz = 119 calories
steel:	1 gm = 8.2 calories	1 oz = 232 calories
aluminum:	1 gm = 54.7 calories	1 oz = 155 calories
plastic:	1 gm = 10.3 calories	1 oz = 292 calories

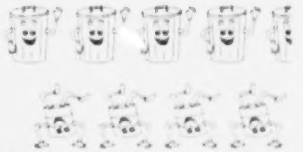
[1] figures are from: Fritsch, A., *et al*, ***Energy and Food***, Center for Science in the Public Interest

A-Way with Waste

A-Way with Waste
(3rd Edition)

Washington State
Department of Ecology
3190 160th Avenue, S.E.
Bellevue, WA 98008-5452
Attn: Jan Lingenfelter (206) 649-7043

$28.50



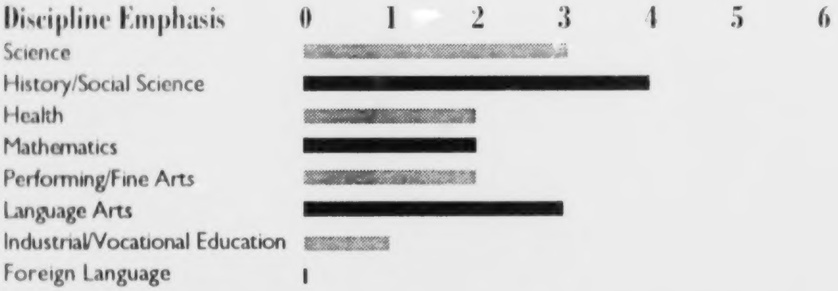
This curriculum is written and organized to present integrated waste management concepts affecting land, air, and water in the ecosystem. The activities are designed to promote awareness, attitudes, and actions to solve waste management problems at home, in school, and in the community. 570 pages, 1990 (an updated version set for release in September 1993).

Grades K-12

Report Card

General Content	A+
Presentation	B+
Pedagogy	A-
Teacher Usability	A+
Solid Waste	A
Hazardous Waste	A

Discipline Emphasis



Comments

General Content

The entire curriculum has a logical flow that builds on the basic premise of reduce, reuse, recycle. Great interdisciplinary connections. Too much material for some teachers; ideas are spread thinly - not concentrated.

Presentation

The layout is great, and the lessons are easy to follow. "Really great graphics."

Teacher Usability

"Some innovative stuff, but you have to wade through masses." This much material can be overwhelming. "It's rather long - do teachers have time to implement what it has to offer?" Efficient indexing, thorough, complete resources, and good background information make this easy to use.

Solid Waste

"It gives a completely thorough presentation on hazardous and solid waste in an interesting, stimulating way!" A stronger emphasis on buying recycled products is needed.

Hazardous Waste

(See above comment). Many discussions of hazardous waste are teacher-directed.

Additional Teacher Thoughts

"Top-notch work all around." Although some activities are Washington State-specific, there is so much here that this is not a problem. "Love the simulations."

Putting Your Product In A Package

Subject: Consumer Education, Business, Economics, Design, Industrial Arts
Grades: 7-12
Teaching Time: 45 Minutes
Focus: Packaging, Waste Reduction

Rationale

Packaging is the largest single component of household solid waste[1]. Many materials produced for the marketplace, however, need to be packaged in order to protect them during shipping. At the retail outlet, packaging serves to advertise products and identify contents, and may be required to meet regulatory standards.

Learning Objective

Students will:

- Understand some of the benefits and drawbacks of packaging.
- Understand the function packaging plays in protecting and marketing products.
- Design packages which reflect their awareness of the waste reduction and resource conservation consequences of packaging decisions.

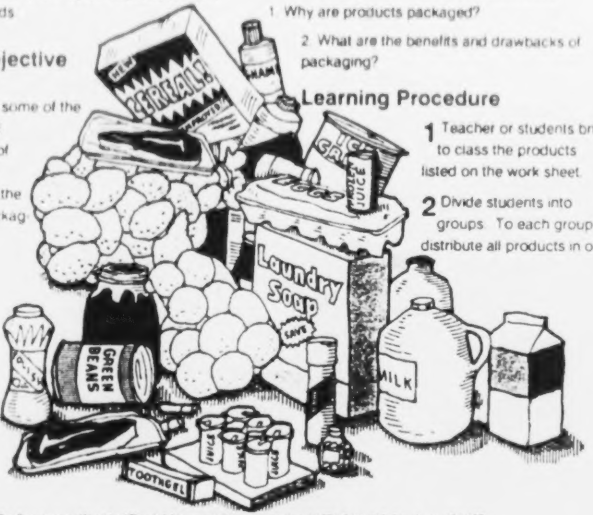
Materials

- The packaged products listed on the work sheet.
- Packaging information sheet and packaged products work sheet.
- Materials for design/construction of prototype packages.

Pre And Post Test Questions

1. Why are products packaged?

2. What are the benefits and drawbacks of packaging?



Learning Procedure

1 Teacher or students bring to class the products listed on the work sheet.

2 Divide students into groups. To each group, distribute all products in one category. Product categories are listed on the following "packaged products work sheet."

3 Ask each student to design a new package for a product of his or her choice.

4 Discuss with students the packaging information sheet.

5 Ask students to list on the work sheet the function and design considerations they feel are important in designing the packaging of the products they are examining. **Ask:** "Why did the producer package his product this way?" "How else might this product have been packaged?"

6 Ask students to identify the packages which could be reused or recycled.

Ask: "How can we reuse or recycle the packaging materials after we have used the products?"

Ask: "What will happen to the packaging we cannot reuse or recycle?"

Ask: "How can we as consumers reduce the 4.8 pounds of waste we, in Washington State, produce everyday?"

7 Using the following "Packaging Information Sheet," have students develop design specifications for the packaging they will create. Challenge students by explaining their designs must include considerations of waste reduction, reuse, and recycling, as well as public safety, product protection, shipping weight, cost of packaging material, advertising, and public demand.

8 Share with students the materials you have provided for designing and making prototype packaging for their products.

9 Ask students to present drawings/prototypes to class and explain the reasoning for their design.

Extended Learning

1. Have students write to and send their designs/prototypes to packaging manufacturers as suggestions for improvement in package design.

2. Analyzing a variety of products, measure the actual amount of the product compared to the size and shape of the product's package.

3. Invite representatives from the grocery business and the packaging industry to class to discuss packaging.

4. Research the regulatory standards packagers and retail outlets are required to meet. **Ask:** "Who sets these standards? Why are they required?"

Resources - *See the Department of Ecology resource book for materials available to use with this activity*

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[1] White, Peter T. "The Fascinating World of Trash," National Geographic, April 1984, Vol. 163, No. 4, pp. 424-457.

The No Waste Anthology

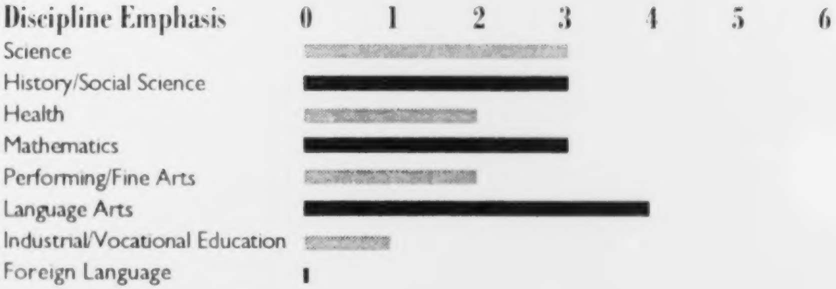
The No Waste Anthology
California Department of Toxic
Substances Control
P.O. Box 942732
Sacramento, CA 94234-7320
(916) 322-0476

Free.

A compilation of interdisciplinary, action-oriented, cooperative problem solving activities focusing on pollution prevention. Divided into three sections: Natural Resources and Pollution Solid, Waste, and Hazardous Waste. 320 pages, 1991.

Grades K-12.

Report Card	
General Content	B+
Presentation	A-
Pedagogy	B+
Teacher Usability	A+
Solid Waste	A-
Hazardous Waste	A+



Comments

General Content

Not enough real science investigations; "Is scientific information really science?" "Overall this is an excellent curriculum because it emphasizes personal strategies for helping solve solid and hazardous waste problems."

Presentation

The activities, many taken from other publications, are concise and well-written. Not a curriculum, but rather a sourcebook of compiled activities. Interrelates local and global issues in an effective way. Has great graphics for reproducing.

Pedagogy

Could be improved by adding science experiments at the 7-9 grade level.

Teacher Usability

An excellent resource that has the "best" activities from other projects presented in an easy-to-understand manner. It might be useful to divide the chapters by grade level. As is, it might encourage a hit-and-miss approach rather than a coordinated approach. Excellent background material is provided for both the student and teacher, along with an extensive resource list.

Solid Waste

Could be improved by emphasizing the waste management hierarchy; waste reduction taking precedence over recycling and reusing. "Lacked strong information on composting and source reduction strategies in industry and business."

Additional Teacher Thoughts

"A great add-on book, a must for every educator." "This would seem to be an invaluable book for teachers interested in waste management." "Just what it says it is - a good anthology."

INCREDIBLE EDIBLE LANDFILL

Goal:
Students will be able to state some of the problems with landfills and waste disposal

School Subject:
Social Studies

Grades:
6th – 12th

Time:
1 class period (one evening of preparation)

Materials:
- Plastic mixing bowl
- 3 different flavors of jello
- Pistachio pie filling
- Chocolate pudding
- Butterscotch pudding
- Pineapple ice cream topping (chunky)
- Creme de menthe ice cream topping (syrup)
- Licorice swizzles
- Root beer barrel candy
- Jelly/nougat candy
- Iced blue lozenges

Optional
- Plastic cars, insects, furniture bottles, etc
- Jar of water
- Vegetable oil
- Pieces of rubber
- Nails
- Dirt or Gravel
- Vinegar

PREPARATION

1. Using the plastic container as a mold, pour in a layer of jello and allow it to set. Remember the first layer poured will be the top of the landfill, but will have the rest of the layers on top of it in the bowl.

2. Add root beer barrels, licorice swizzles, or any other materials to the layer when it is partially gelled.

3. Pour successive layers and add barrels, etc. Allow mold to set.

PROCEDURE

1. Tell students: After studying some of the issues involved in chemical waste in the United States today, it should be interesting to see what kinds of decisions we can make regarding disposal and treatment. Here is a model of a chemical landfill. **Ask:** Can you identify the liner? Point out the leachate seeping out.

2. Challenge the students to eliminate the "waste" before the end of the period. Remove the liner so that the students can inspect the contents. (Explain that all materials are edible and list ingredients to the class.) Tell students: Our edible landfill will represent all the chemical waste in the United States today. Proper treatment of the waste will be represented by consumption of the jello mold. If each of us take an equal share of the jello mold and consume it, there will be none left at the end of the period. Whatever material remains will continue to be a problem for future generations.

3. Consume the "waste"

Alternative 1
The instructor can use different colors of jello and place toy cars, plastic insects, bottles, and candies such as gummy bears etc., into the layered jello. This is a more accurate graphic display of a landfill. The students would not, of course, consume such an inedible presentation.

Alternative 2
Another option is to use a jar of water, and add to it 2 oz. vegetable oil, 2 oz. vinegar, pieces of rubber, several iron nails, a handful of dirt or gravel and food coloring. Explain to the students that this jar represents various hazardous substances which may be present in a hazardous waste dump. Ask: How can this water be cleaned up? (Pieces of rubber could be pulled out with tweezers; nails could be removed with a magnet; dirt or gravel could be filtered out; oil could be soaked up with paper towel)

Here are some examples of applications for real life, using the model:

Model	***Real World***
Incredible Edible Landfill	chemical waste
mold	liner
root beer barrels	barrels of toxic waste
jello	chemical sludge
iced blue lozenges	aromatic, organic wastes
liquids formed	leachate
eating the jello	proper treatment
discarding the jello	illegal treatment
extra credit for eating	incentive

Although the Incredible Edible Landfill is not aesthetic or appetizing, neither is the problem of chemical waste!

Adapted from ***THE INCREDIBLE EDIBLE CHEMICAL LANDFILL*** by Rich Wagner, Wissahickon Senior High School, Ambler, PA and from ***CALIFORNIA CLASS PROJECT, 1984***

Closing the Loop

Closing the Loop
Integrated Waste Management
Activities for School and Home

The Institute for
Environmental Education
18554 Haskins Road
Chagrin Falls, OH 44023-1823
(216) 543-7303 Mary Chadbourne

$32 for K-12
$28 for K-8
$26 for 9-12

A collection of activities grouped under three thematic sections: Everything Ends Up Somewhere, We Have Options And We Make Choices, and Everything Is Connected. Activities are intended to be hands-on, problem-centered, practical, and adaptable across grade levels and subjects. 1991

Grades K-12

Report Card

General Content	A
Presentation	B+
Pedagogy	A-
Teacher Usability	A
Solid Waste	B+
Hazardous Waste	B+

Comments

General Content

Good emphasis given on personal actions students can take to reduce trash, especially with buying less packaged materials. This is one of the few that contained learning experiences on population growth.

Presentation

Excellent graphs and charts provided. Interesting projects for students to do. Makes good connections between local and global issues.

Pedagogy

Activities are comprehensive, varied, and activity-oriented. Includes real experiments, as well as group discussions and role-playing.

Teacher Usability

Accessible to teachers - well-organized, easy to read and use. Some of the activities are Ohio-oriented and would need to be adapted for use in California.

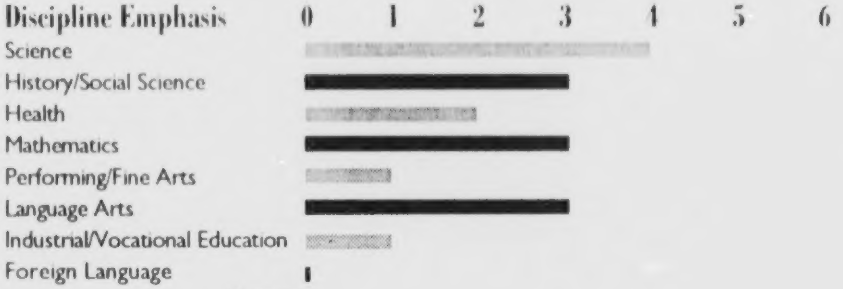
Solid Waste

More information on solid waste than on hazardous waste. "While it might be entitled 'Closing the Loop,' very little attention is given to buying recycled products to stimulate the market."

Additional Teacher Thoughts

"One of the most thoughtfully conceived curricula I've seen." "Few weaknesses. Good stuff!" "Great curriculum, great program, each lesson very complete."

Discipline Emphasis



121

122

HOW TO CALCULATE BTUs PER CONTAINER

Grades: 5-8 & 9-12

Subjects: Mathematics, science, chemistry, physics, home economics

Format: One class period; homework assignment for calculations optional

TOASTY OATS CEREAL
SODA
SOUP
NON FAT MILK

OBJECTIVE: Students will (1) compare the energy used for the package or container with the energy actually in the food itself, (2) calculate how much energy is used to produce the food containers they bring to class; (3) understand, in general terms, how much energy can be conserved by recycling packaging materials and that conservation of energy is as important as finding alternative sources of energy -- energy can be conserved by careful buying and by recycling.

BACKGROUND: The unit of heat energy used in science is the calorie (cal.), also called gram-calorie or small calorie. It is defined as the amount of heat energy needed to raise one gram of water 1° Centigrade.

In nutrition, the unit of food energy is the Calorie (Cal.), also called kilogram-calorie, or great calorie. It is defined as the amount of energy needed to raise one kilogram of water 1° Centigrade. It is equal to 1,000 calories.

The small "c," capital "C" difference is important. Only the nutritional calorie uses capital C.

Engineers use a different heat energy standard called the British thermal unit (Btu). It is defined as the quantity of heat required to raise the temperature of one pound of water 1° Fahrenheit. One Btu = 250 calories. (NOTE: 1 pound = 454 grams; C = 5/9 (F - 32) 1 kilogram = 2.2 pounds)

Our thanks to the Washington State Department of Ecology for its permission to use/adapt this activity from *A-Way with Waste*.

MATERIALS:

- Containers (brought by students)
- Charts titled "Btu/Calorie Comparison Chart for Manufactured Goods," "Energy Used by Packaging Materials" and "Environmental Benefits of Recycling"
- Calorie counter booklet (these are available at grocery check-out counters for under $1.00; they may also be available in a health textbook)
- Scale - capable of weighing an ounce up to 2-5 pounds

PRE-ACTIVITY QUESTIONS:

A. What does Btu stand for?

B. Which takes more energy to produce: an aluminum can or a tinned can?

PROCEDURE:

A. Ask students to weigh the containers they have brought to class. (Where required, cut packaging into smaller pieces and stack or weigh pieces separately to get the total package weight.) Give them the chart titled "Btu/Calorie Comparison Chart for Manufactured Goods" (at the end of the activity), and ask students to calculate the energy in Btus used to produce each container.

B. Look up the Calories of the food that came in the container and compare the energy used to produce the container with the energy that the food contains. Use a Calorie counter booklet or the USDA handbook, "Nutritive Value of American Foods for Caloric information." (See Bibliography)

C. Other ideas: Since aluminum is so light, students often wonder if making an aluminum can uses fewer Btu's than making a tinned steel can. Find a steel can of the same size and weight as an aluminum can. Determine if the aluminum can used fewer Btu's than the steel can. (Use the chart titled "Energy Used by Packaging Materials" at the end of the activity.)

D. Determine how much energy is saved by buying a product in one large container rather than in several smaller ones: use milk cartons/jugs, cereal boxes, cans, etc. Compare nutrition received to energy needed to produce the container - 1 large

Bags... Beakers... and Barrels

Bags...Beakers...and Barrels
Industrial States Policy Center
17 Brickel
Columbus, OH 43215
(614) 224-4111

Call for cost information.

A five unit curriculum designed to help students better understand the problems associated with hazardous materials. Units progress towards completion of a community action project. 1987.

Grades 7-12

Report Card

General Content	A
Presentation	B+
Pedagogy	B+
Teacher Usability	A-
Hazardous Waste	A-

Comments

General Content

Good use of real-life scenarios - "Right out of the news." While it is mainly aimed at science and social science classes, science application/lab activities are lacking. Comprehensive and imaginative.

Presentation

Well-written and organized, with good graphics and background information. Presents differing views and opinions showing the dilemmas that are connected with this issue.

Pedagogy

There are many thought-provoking simulations and some student-led research that leads to action. Could be improved with more exploratory, hands-on activities.

Teacher Usability

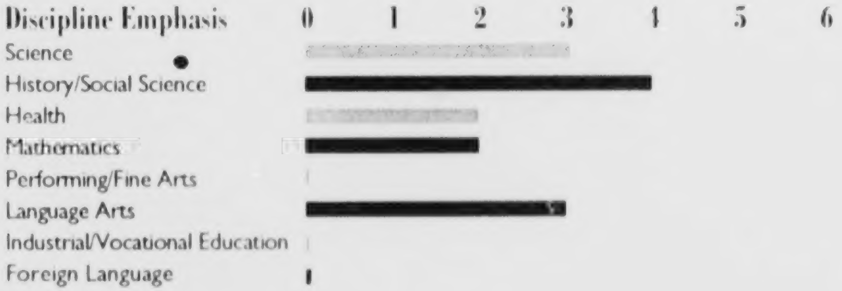
The curriculum is easy to follow and implement, although it could use more background information. The resource list is clearly done and fairly comprehensive.

Hazardous Waste

Offers a very thorough explanation of the issues, including hazardous waste laws.

Additional Teacher Thoughts

"Has uplifting, positive notes to ward off student and teacher depression." "Classic S-T-S (science-technology-society) curriculum. Well done, brings out positive aspects."



3. Global Links

ACTIVITY: Individual work.
MATERIALS: World maps, markers or colored pencils.
TIME: 20 minutes and homework.

It's easy to forget that our own actions affect the entire world. We use many raw materials that come from other countries which in turn are sold overseas. When it comes to hazardous waste, every industry risks contaminating the local environment which eventually affects the environment on a regional and global basis. Policies and technology may not be effective enough to clean up the chemicals properly in developing countries. Other factors, such as the market place or the political climate, may govern the method of hazardous waste management in developing countries.

OBJECTIVES:

- Students will begin to understand that common, everyday things have links all over the world.
- Students will review and improve their knowledge of geography.

TEACHER PREPARATION:

1. Obtain global maps and duplicate them for each student.
2. Duplicate Handout 3A.

CLASS ACTIVITY:

1. Distribute the maps and the handout. Ask the students to read about the global connections that jeans create, and to mark on their map the countries that might be involved in the production of their pants! Students may prefer to use different colors to differentiate raw materials from processing stages. Explain that wherever a resource is mined, harvested, or processed, there is usually a risk of hazardous waste contamination.
2. After the maps are marked compare maps, and have the students review the countries involved. Answer their questions, and encourage them to think about the global links for other products.
3. Ask the students to work in groups, selecting a manufactured product which they use that produces a risk of hazardous waste in its production and which is likely to have international roots. Examples include: cars, plastic items, a diamond ring, an aluminum can.
4. Have them research the ingredients used in the manufacture of this item and the source of these items.
5. Using more world maps, have each group map out the sources and connections that their product made with the rest of the world. Ask them to highlight potential hazardous waste locations.
6. As a class, discuss how the students feel about these global links. What impact does this have on America and on the people in other countries?

FOLLOW-UP:

1. In Chapter 4, the first two activities relate to everyday items that produce hazardous waste by virtue of their production: Hazardous Waste Card Games and Baker's Dozen.
2. You may want to refer back to Handout 2A to discuss possible health hazards to workers and living organisms potentially exposed to wastes in the environment.

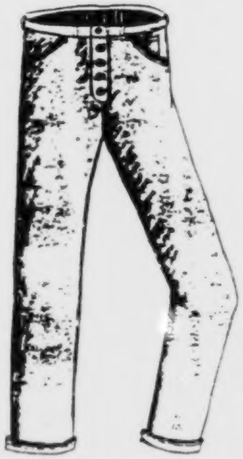
STUDENT HANDOUT 3A

WHAT'S HAZARDOUS ABOUT YOUR PANTS?

Denim is made from cotton, which is grown in warm climates. Southern U.S., USSR, Brazil, Pakistan, Turkey, China, India and Egypt were top cotton producers in 1984.

Pesticides are sprayed on cotton fields to kill boll weevils. These chemicals have endangered workers and contaminated the soil.

In some cotton mills, workers risk brown lung disease from breathing airborne fibers.



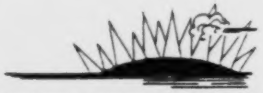
The patented rivets in Levi's jeans are made of copper. This ore is mined in Canada, Mexico, Peru, Chile, and the US.

What environmental problems might you find near the mines?

Blue dye is made from indigo, an export of Java, Japan, Brazil, and the West Indies.

Dye is a major source of water pollution from most textile plants.

Energy is used to plant, spra and pick cotton; to mill and clean cotton; to dye and process the cloth, and to sew jeans. From where do we obtain petroleum fuel? The drilling, transporting, and processing of oil poses many potential hazards.



PESTICIDES AREN'T THE ONLY WAY

Cotton receives more pesticides than any other crop in the world, but it may not for long. Because of the great expense of petroleum-based pesticides, the health risk to field workers, and the potential harm to the soil, scientists and farmers are experimenting with new techniques to grow crops. They have had great success with integrated Pest Management. It uses naturally occurring pest controls (predators and parasites), sterile insects, crop rotation, and special plant varieties to increase crop yields. In Texas, farmers trying this new system used 50% - 75% less pesticide and 80% less fertilizer. Their profits tripled!

The Waste Hierarchy

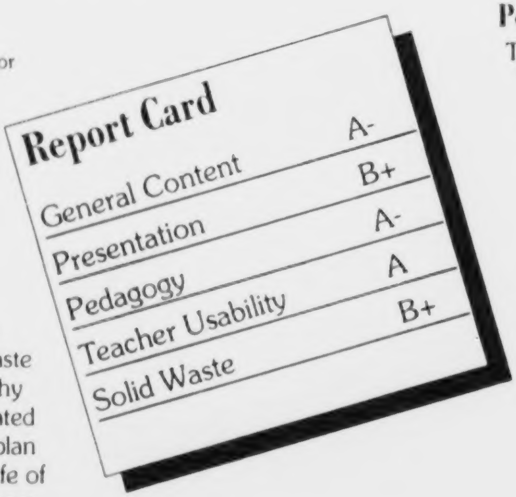
The Waste Hierarchy:
Where Is "Away?"

SEPUP (Science Education for
Public Understanding Program)
Lawrence Hall of Science University
of California, Berkeley
1 Centennial Drive
Berkeley, CA 94720
(510) 642-8718

$225, includes materials for 160 students.

SEPUP is a diverse educational program highlighting chemicals and their uses in the context of societal issues. Students will learn to apply the waste management hierarchy to develop an integrated waste management plan that will extend the life of their landfill. 154 pages, 1993.

Grades 7-9.



Report Card

General Content	A-
Presentation	B+
Pedagogy	A-
Teacher Usability	A
Solid Waste	B+

Comments

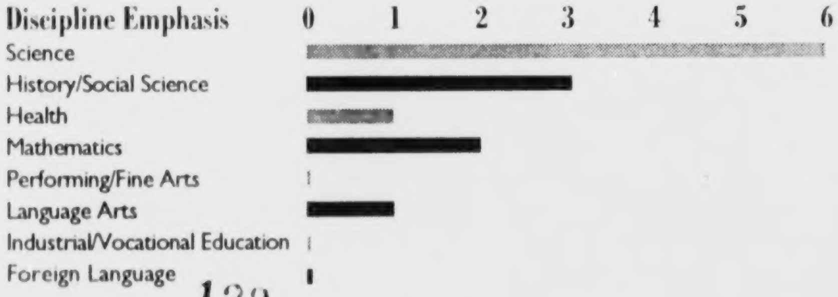
General Content
Well suited for chemistry/science teachers wishing to integrate societal and environmental issues into their lessons. Chemistry concepts involved might be threatening to some non-science teachers.

Pedagogy
These lessons are challenging, exciting, hands-on, and scientific. "Still not a constructivist point of view toward acquiring knowledge."

Teacher Usability
Although the lessons are very good, they are not easily modified. Activities are easily integrated into an established curriculum. The background information is thorough, and workshops are available to assist with teacher usability.

Solid Waste
In addition to solid waste, this module does a good job of covering a few hazardous waste issues. The waste management hierarchy was given strong emphasis, and the advantages of dealing with waste in this manner were made clear.

Additional Teacher Thoughts
"A model of what children should be doing in middle school science. Investigative, open-ended, evidence-based decision making on important social/environmental issues."



Name *Date* *Period*

STUDENT SHEET 4·1

Recycling Plastic

Purpose

You will compare the properties of recycled plastic to plastic that has not been recycled. You will explore the possible uses of recycled materials and examine the products of the recycling process.

Materials

For each pair students:

- CEPUP tray
- Piece of white paper
- Stirring stick
- Dropper
- Plastic film strip 1/2" x 1" (1 cm x 2 cm)
- Paper towel
- Strip of pH paper

For each group of four students:

- 30 mL dropping bottle of 1% household ammonia
- 30 mL dropping bottle of 0.5 M hydrochloric acid solution
- 30 mL dropping bottle of water
- Scissors

Safety notes:
Do not touch the solutions or bring them into contact with your eyes or mouth. Wear safety eyewear as directed by your teacher.

Procedure

1. Describe the plastic film (color, density, flexibility, the way light is reflected from it). Record your observations in Data Table 1.
2. Cut the plastic film in half. Place one of the pieces in large Cup A of your CEPUP tray. Add 50 drops of water. Stir with the flat end of the stick. Add a small piece of pH paper to the cup.
3. Record your observations of the plastic film and the color of the pH strip in Data Table 2.
4. Place the other piece of plastic in large Cup B of your CEPUP tray. Add 50 drops of 1% household ammonia to large Cup B. Stir with the flat end of your stirring stick until no further change takes place.
5. Touch a small piece of pH paper to the solution in Cup B. Then take it out and place it on the paper towel. Record your observations of the plastic/ammonia solution and the color of the pH paper in Data Table 2.
6. With a dropper, transfer the contents of large Cup B to large Cup C. While stirring, add 40 drops of hydrochloric acid solution to Cup C. Touch a piece of pH paper to the solution in Cup C. If its color is green or blue, add 5 more drops of hydrochloric acid and retest the solution with another piece of pH paper. Record your observations in Data Table 2.

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STUDENT SHEET 4·1 (CONTINUED)

7. Carefully remove all of the reclaimed plastic to large Cup D. Some of the plastic may stick to the stirring stick. Add 50 drops of water to Cup D. Touch a small piece of pH paper to the solution in Cup D. Record your observations in Data Table 2.
8. Use the information below to determine whether the solution is acidic, basic, or neutral in Cups A, B, C, D. Record your observations in Data Table 2. Acidic = yellow, orange or red paper color
   Neutral = yellow green to green paper color
   Basic = dark green to blue paper color
9. Remove the plastic from Cup D and place it between layers of the paper towel. Press down to squeeze out the water. Examine your recycled plastic. Try pressing it against a penny or shaping it with your hands. Record its appearance and properties in Data Table 1.
10. Remove the plastic from Cup A to the paper towel. Record its appearance and properties in Data Table 1.
11. Allow your recycled plastic to dry overnight and then re-examine its properties. Record its appearance and properties in Data Table 1.
12. Clean up as directed by your teacher.

Data Table 1: Properties of plastic film strip before and after recycling

Material	Appearance	Properties
plastic film strip		
plastic film strip soaked in water		
wet reclaimed plastic		
dried reclaimed plastic		

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Teacher's Resource Guide

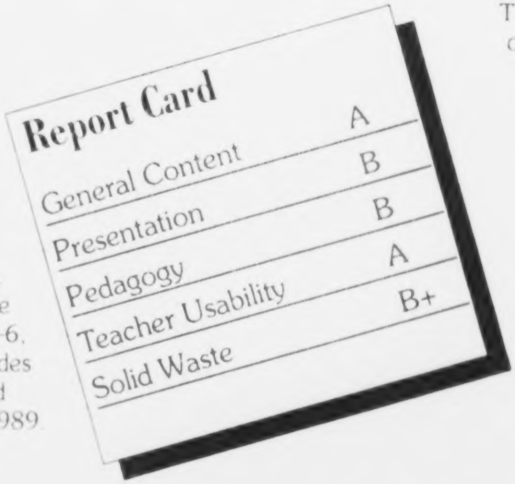
Teacher's Resource Guide for Solid Waste and Recycling Education

Association of Vermont Recyclers
P.O. Box 1244
Montpelier, VT 05601
(802) 229-1833 Ivy Zeller

$45

This guide is designed to help Vermont teachers integrate solid waste and recycling education into their existing schedules and required courses. It is divided into grade level sections (K-3, 4-6, 7-8, 9-12), and includes large information and resource sections. 1989

Grades K-12



Report Card

General Content	A
Presentation	B
Pedagogy	B
Teacher Usability	A
Solid Waste	B+

Comments

General Content

Includes several original activities. The lessons are too simple, and the scope of materials at 7-9 is a bit vague and not comprehensive.

Presentation

The graphics would work well in the classroom and are easy to duplicate. Good format.

Pedagogy

All the good information is in the teacher's resource section, and the lessons rely on teachers integrating that background information.

Teacher Usability

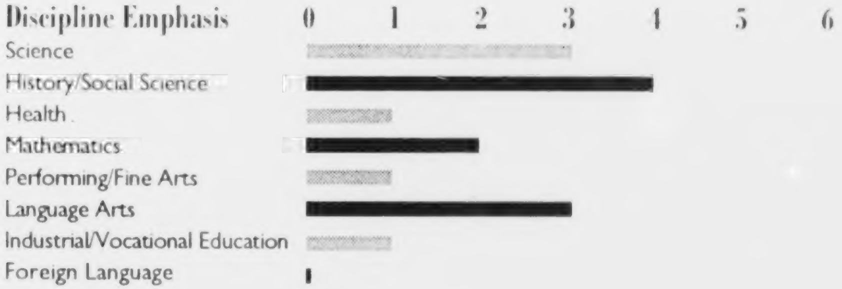
Well organized and clear on objectives and instructions. The materials were made for Vermont teachers, so some changes would be needed for use in California. "User-friendly," with excellent background information and resource guide. Sources are also listed in the lessons themselves.

Solid Waste

Provides a good overall view of solid waste issues.

Additional Teacher Thoughts

A consistently good package, containing some interesting, unique ideas.



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LANDFILL SOIL

7-8 ● II.B.2

Concept
By carefully analyzing different environmental, social, and economic factors, communities may select the most appropriate and least harmful method for disposing of solid waste.

Objective
Students will determine the importance of soil studies prior to the siting of landfills.

Method
Students will compare the water-holding capacity of various soils.

Materials
Empty milk or juice plastic containers, cups of pebbles, gravel, coarse sand, fine sand, topsoil, clay (any soil samples available), watch or clock with second hand, jars of water, bowls, measuring cup, student worksheets (one per pupil or group).

Subjects
Science, Geology.

Skills
Observing, recording.

Time
40 minutes.

Source
Oscar's Options.

Resources
Solid Waste Districts; State of Vermont Solid Waste Management Rules; State Geologist; geologic survey maps.

AVR Guide Resources

PARALLEL ACTIVITIES
K-3 ● III.A.3 Litter Garden;
4-6 ● II.B.1 Landfills;
7-8 ● II.B.1 Mini Landfills;
9-12 ● II.B.1 New Landfills;
II.B.2 Methane.

INFORMATION
II.B.2 Landfills.

RESOURCES
A.5 Landfills, C.4 General.

BACKGROUND

The nature and composition of subsurface material should be known for a distance of at least 20 feet below the lowest part of the landfill, to bedrock, or to the water table, whichever is shallower...Landfill base soil should be relatively impermeable and have some capability to attenuate or remove contaminants expected in leachate...The development of a landfill in areas underlain by bedrock is not recommended because of the possibility of groundwater contamination through fractures in the bedrock...All other factors contained in these guidelines notwithstanding, it is expected that some unquantifiable amounts of leachate will enter the groundwater within the zone of influence. In particular, the organic fraction of the leachate receives little or no attenuation while passing through even the best base soils. Therefore, the determination of the potential zone of influence and the landfill's possible effect on this area is the most critical portion of the hydrogeologic evaluation of a proposed site.

— Excerpts from State of Vermont's
Guidelines for the Landfill Disposal of Solid Waste

LEADING QUESTION

Why is it important to test the soils of a potential landfill site?

PROCEDURE

1. To prepare containers, perforate the cap of each plastic jug and cut off the bottom end. Replace the cap, then fill the container about two-thirds full with one kind of soil. Repeat with as many types of soil as desired. In addition, prepare a separate container of soil in which you place several tablespoons of powdered paint into a well in the soil, and cover completely so that students will not know the paint is there.

2. Select one of the soil containers. Pour in one pint of water, noting the time you begin to pour. Place a bowl underneath the container cap to catch the water. Record how much time passes before the water starts dripping into the bowl and the duration of the water dripping. Measure the amount of water that came through and compare with the amount with which you started. Discuss what happened to the remaining water. What conclusions can be drawn?

3. Repeat the experiment with each type of soil. When the experiment is performed with the soil containing the paint, the students should be surprised to see colored water. Discuss with students the fact that, like the paint, there are many hazardous wastes buried in the ground which are not detectable to the eye. Although the land beneath a landfill may look all right, continuous testing must be done to detect hazards before they leach into groundwater supplies.

Vocabulary: groundwater, hazardous waste, leach, percolate, soil, zone of influence, attenuate.

EVALUATION

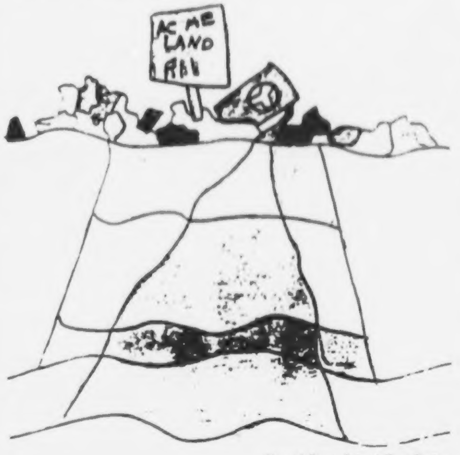
What types of soil would students recommend be the base for landfills? Why?

EXTENSIONS

A. Fill several large cans with soil, each with a different type, (gravel, sand, clay, etc.). Press a sharpened pencil into each can to see how far it can be inserted. Compare and record results. Next, wet the soils and try again. Let the soils dry and record results a third time. Students can make comparisons among the soils and among the three tests, and make judgements on which types of soil were the most or least compact. Compare results with the above experiment.

B. Consider the following problem: There is a swamp about fifteen miles from your town. The land cannot be used for farmland and no one builds homes in a swamp. Would this be a good location for a future Vermont landfill?

C. Simulate the siting of a new landfill in your community. See 9-12 ● II.B.1 NEW LANDFILLS.



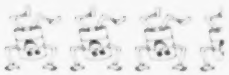
Newark Street School, West Burke

Teaching Toxics

Teaching Toxics
Creating Solutions to
Household Pollution

The Association of Vermont Recyclers
P.O. Box 1244
Montpelier, VT 05601
(802) 229-1833 Ivy Zeller

$25.



A collection of activities which enable students to become aware of the environmental and health impacts of household hazardous wastes. Consists of four grade-level activity sections (K-3, 4-6, 7-8, 9-12), an information section and a resource section. 104 pages, 1992.

Grades K-12.

Report Card

General Content	B+
Presentation	B+
Pedagogy	B
Teacher Usability	A
Hazardous Waste	A-

Comments

General Content

Good integration of different disciplines.

Pedagogy

Contains good activities that make a real attempt to have students do labs; however, the labs are more "cookbook" than constructivist.

Teacher Usability

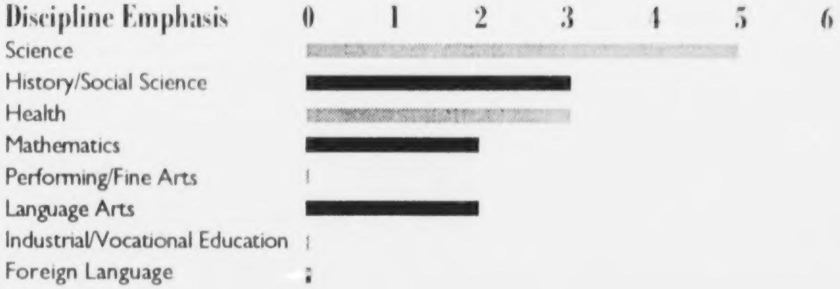
This guide is concise, to the point, and well-organized. The resource list is easily used, although a bit heavy on Vermont resources.

Hazardous Waste

Does not cover all aspects of hazardous waste issues (as outlined in the evaluation questions), but is a good introduction to household hazardous waste in the home and school. A significant amount of background on toxic/hazardous waste is contained in the information section and not in the lesson plans themselves. This guide does an excellent job on alternatives to hazardous materials, and may help students be aware of harmful substances in their lives.

Additional Teacher Thoughts

"A great, short, integrated, and hands-on science unit dealing with household toxic waste."



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7 - 8 : Toxicity: A Relative Term

Subjects
Health, Science, Language Arts

Skills
Problem solving, forming hypotheses, observing, interpreting, drawing conclusions

Materials
Per student group: eight lima bean plants, bottle of vinegar, pH testing paper, container large enough to hold three liters, three 200 ml beakers, ruler

Time
These experiments take approximately 2 - 3 weeks; about two class periods for set up, observation and discussion

Vocabulary
Absorption, inhalation, ingestion, risk assessment, ppm/ppb (parts per million/ billion), equivalent, analogy

Related AVR Guide Activities
K - 3 Prevention Is The Best Medicine, 4 - 6 Accidents Don't Have To Happen

Source
"How Small is Small" Extension adapted from Lacustrine Lessons "A Drop in the Bucket"; *Michigan Cooperative Extension Service Extension Bulletin*, August 1982

Concept
The toxicity of a chemical is determined by its concentration, its amount and the individual characteristics of the person exposed to it.

Objective
Students will become familiar with what determines toxicity by performing a series of experiments.

Background
See Information Section, pages 78-80. Something that is toxic is capable of harming living things. Congress has defined a toxic substance as a chemical or mixture of chemicals whose manufacture, processing, distribution, use or disposal may present an "unreasonable risk" to the health of people or the environment. "Unreasonable risk" is an ambiguous term. It is often a value judgment that decides what is unreasonable.

Many factors determine how harmful a toxic substance is to an organism. Toxicity is largely determined by its concentration and the dose (amount) taken. Some materials may be toxic in minute quantities (such as dioxins). Others, such as table salt, need to be taken in large quantities to have any toxic effects on an organism. An individual's characteristics influence the toxic effects of a substance. These characteristics include: genetic factors, lifestyle choices (smoking, alcohol consumption), gender (women accumulate more fat-soluble toxins in their bodies than men), age (the very old and the very young are more susceptible to the effects of toxic substances) and allergic sensitivity (many individuals experience an allergic reaction to some toxic chemicals even in low amounts and concentrations).

Activities

Introduction to Toxics

- Ask student groups to predict what they think influences a toxic substance's effect on our bodies. List the main things that influence toxicity: ***concentration, amount*** and the ***characteristics of the individual exposed***.
- Explain to students that some of the same hazardous substances used in industry are used in household products. However, when these substances are used in household products they are in lower concentrations and smaller amounts.

Toxicity and Concentration (Experiment: Concentrating on Toxicity)

Teacher preparation: (Per small group) germinate eight lima bean seeds in containers with soil and water, as needed, until plants grow to be 3" - 5" in height. At this point the experiment is ready to begin.

These experiments take approximately 2 - 3 weeks.

- Students will water four plants with different concentrations of vinegar-water solution to determine how different concentrations affect plant growth. (See the student sheet on the following page for detailed instructions.)
- After the experiment is finished, discuss the following questions.
  - — Were your predictions correct?
  - — Which solution has the greatest amount of vinegar in it? Which solution was the most toxic to plants?

Toxicity and Amount (Experiment: How Much is Too Much?)

- In this experiment students will water four plants with different amounts of the same concentration of vinegar-water solution. (See the student sheet on the following page for detailed instructions.)
- After the experiment, discuss with the class the following questions.
  - — Were your predictions correct?
  - — Based on your experiments, how would you define toxic?
  - — Do you know of any products in your home that are toxic to humans an animals?
  - — What is the difference between amount and concentration?

Toxicity and Individual Differences

- Ask the class, "Are all people affected the same way if they are exposed to a toxic substance?" In small groups, have students list all the differences between an infant and a 60-year-old person; a smoker and a nonsmoker; a person with a life history of kidney problems and a person with healthy kidneys. (Note: Remind students that the kidneys help the body to detoxify substances that have been absorbed in the blood.)
- Ask the small groups to decide who is most likely to be affected by toxic substances and to give their reasons for their choices.
- Have the groups report their discussion to the class.

Problems in Determining Toxicity

- Based on their experience, have students write a paper on why it is difficult to determine if something is toxic.

Extension

How Small Is Small?

- Discuss the information in the box with the class. In small groups, challenge students to develop a procedure to make a solution that has one part per million of food coloring in water.

One part per million means that for every million parts of a solution or mixture, there is one part of the substance being measured. Scientists use parts per million (ppm) to describe the amount of a toxic substance which can be "safely" taken into the human body. When we say something has a concentration of one ppm, picture one inch in a distance of 15 3/4 miles; or one minute over a span of two years.

The California CLASS Project

The California CLASS Project

(Classroom Learning Activities in Science and Social Science)

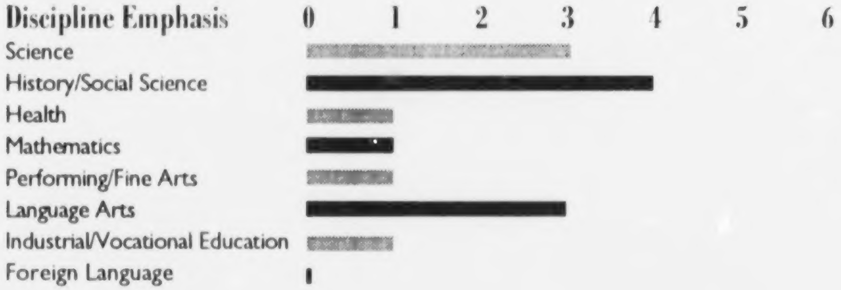
Developed by: National Wildlife Federation and the Orange County, CA Superintendent of Schools
Distributed by: California Department of Education
Bureau of Publications, Sales Unit
P.O. Box 271
Sacramento, CA 95812-0271
Item No. 9939
(916) 445-1260

$28 (plus tax for California residents)

A series of 33 classroom-ready lessons presented in six thematic units: Energy Use, Hazardous Substances, Wildlife Habitat Management, Wetlands, Forest Watershed Management, and Environmental Issues. 373 pages, 1992. Currently under revision.

Grades 6-9.

Report Card	
General Content	A-
Presentation	B
Pedagogy	B+
Teacher Usability	A
Hazardous Waste	B



Comments

General Content

Good interdisciplinary curriculum; however, authentic science investigations are lacking. Provides students with real world activities that will help them to understand the environmental issues at a personal level.

Presentation

Great layout and graphics provide for an excellent presentation. Somewhat dogmatic.

Pedagogy

Some activities demand that students think, while others are more "paper/pencil."

Teacher Usability

Easy lesson format for teachers to follow and to know what to expect and prepare. Well-planned activities using good worksheets. Resource listings may be out of date. "Large amount of poorly-written background information."

Hazardous Waste

Strong materials on hazardous waste. Includes some outdated solid waste content.

Additional Teacher Thoughts

"Getting to be a bit out-of-date."

DOWN IN THE DUMPS

3

UNIT II - Lesson 3 Teacher Instructions

OVERVIEW

Students will research information regarding a variety of hazardous waste topics.

FOCUS

Students will:
- compare a demonstration performed in class to the national waste disposal problem;
- study the agencies responsible for controlling hazardous waste;
- determine alternative hazardous waste disposal methods; and
- discuss problems of some hazardous waste dumps in California.

AT A GLANCE

ADVANCE PREPARATION: One month before teaching this lesson, order EPA pamphlets and other materials on hazardous waste (see Digging Deeper).
DURATION: 3 class periods
GROUPING: whole class and small groups
MATERIALS: publications on hazardous waste, large jar of water, empty jar, 2 ounces of vegetable oil, 2 ounces of vinegar, pieces of rubber, several iron nails, a handful of dirt (or gravel), food coloring, magnet, tweezers, plastic bag, paper towels, funnel, plastic tub, and the following:
TRANSPARENCY:
A - Major Federal Hazardous Substances Laws
CROSS CURRICULUM CONNECTION: language arts, social science
PROCESS SKILLS: observing, communicating, comparing, organizing, relating, inferring, applying

VOCABULARY

DDT, Environmental Protection Agency (EPA), leachate, organic waste, PCB (polychlorinated biphenyl), Resource Conservation and Recovery Act, superfund, TCE

BACKGROUND INFORMATION

The Laws

The Resource Conservation and Recovery Act (RCRA) is a federal law which sets the guidelines for the mangement of hazardous waste. It defines hazardous material as any substance which is toxic, reacuve, ignitable, corrosive, infectious, and radioactive or that is included on the Environmental Protection Agency's list of 400 hazardous chemicals. The federal Environmental Protection Agency (EPA) has the authority to enforce the RCRA throughout the United States. See Transparency A for a list of hazardous substances laws. The EPA has delegated the responsibility for enforcing the RCRA in California to the California Department of Health Servcies (DOHS). The DOHS regulates the direct handling of hazardous waste. Waste facilities whose operations could affect the quality of surface or subsurface waters are also regulated by the State Water Resources Control Board and its subsidiary Regional Water Quality Control Boards. These agencies administer state and EPA delegated federal water quality laws. In addition, the state of California has its own Hazardous Waste Control Act. In 1986, at least 83 bills dealing with hazardous wastes and related issues were passed by the California legislature.

Superfund

In 1980, Congress passed the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), often called "Superfund," to address the problem of hazardous waste sites nationwide.

This "superfund" provided $1.6 billion to clean-up old waste dumps and spill sites which are endangering water supplies and/or human health. In 1986, Congress passed a strengthened superfund bill, providing $8.5 billion for the clean-up of abandoned hazardous waste dumps and an additional $500 million to stop leaks from underground storage tanks. This bill also establishes the right of communities to obtain information about the release of toxics into the environment.

Superfund Sites in California

Even with funds available for clean-up, it is difficult to get rid of hazardous waste once it has been dumped in a land disposal site. An example is the Stringfellow Acid Pits, located in a canyon 50 miles east of Los Angeles. This superfund site still contains most of the 34 million gallons of toxic waste dumped there between 1956 and 1972. For 16 years, winter rains overflowed the ponds. In 1981, the ponds were capped with clay. Further clean-up of this site is being attempted. Groundwater tests revealed the presence of toxic chemicals.

Other superfund targeted sites in California include the Rio Bravo Injection Well Facility in Kern County, the BKK Landfill Facility in West Covina, and the Operating Industries Landfill in Monterey Park.

Leaking Hazardous Waste Dump Sites[1]

Under state law, landfills designated as Class I sites may accept solid and liquid waste classified as "extremely hazardous." In 1985, the Environmental Defense Fund, Inc., published a public report based on a survey conducted by six California environmental groups. They performed an analysis on all seven Class I commercial landfills which exist in California. The report states that every one of the seven sites examined had leaks, and every site was also out of compliance with current regulations.

Hazardous Waste Disposal on Land

Hazardous waste disposal methods have been prioritized by EPA in the following order: deep well injection, solidification and encapsulated, and lastly, disposal in a secure landfill. Yet, landfill is the preferred method of disposal by most industries. Disposal of liquid waste in ponds and lagoons is also a common technique. Unfortunately, safety precautions are not observed. For example, consultants for the EPA surveyed 8,163 industrial dump sites (located on the grounds where the hazardous waste was made) and found that nearly 95% of these sites were not monitored for groundwater contamination. In addition, one third of the impoundments were unlined and located above usable groundwater sources.

The EPA is planning to ban landfills by 1991, except for certain specific waste. Presently, landfills must be lined with clay and plastic sheeting. They must also contain leachate collection systems and groundwater monitoring stations.

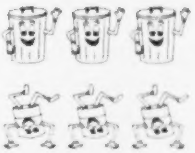
[1] Nowhere To Go, the Universal Failure of Class I Hazardous Waste Dump Sites in California. Prepared by Toxics Assessment Group, Sacramento, CA., June 1985. Copyright by the Environmental Defense Fund, Inc.

Waste: A Hidden Resource

Waste:
A Hidden Resource

Developed by: Tennessee Valley Authority
Distributed by: Keep America Beautiful, Inc.
Ordering Department
West Broad Street
Stamford, CT 06902
(203) 323-8987

$50 plus $5.50 postage and handling.



Designed to supplement existing curriculum, this package is arranged in four chapters: An Overview of Solid Waste, Hazardous Wastes, Municipal Wastes, and A Simulation: Crisis in Center City. 264 pages. To be updated June 1993.

Grades 7-12.

Report Card

General Content	B
Presentation	C+
Pedagogy	B-
Teacher Usability	B
Solid Waste	A-
Hazardous Waste	A-

Comments

General Content

Activities are cross-disciplinary, approaching the topic from several angles. Activities for different subjects (math, science, etc.) are presented separately, with no real attempt to tie them together. Scientific information is not science process.

Presentation

Contains a few unique activities. Includes an easy-to-view curriculum guide. The material is presented in a dry manner, with nothing to catch the attention of the student or teacher.

Pedagogy

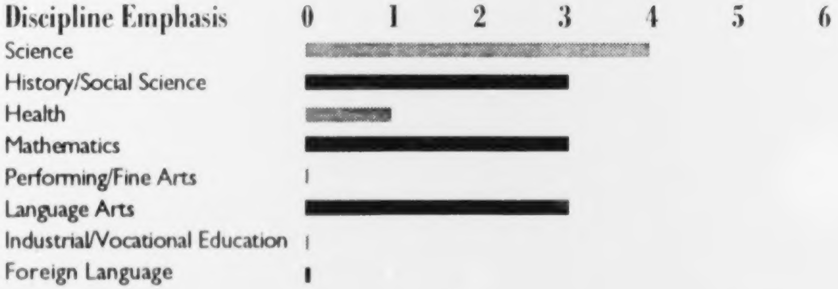
"I like the idea of lab practicum and simulation evaluations together." Some activities are too "paper and pencil."

Teacher Usability

Organized, easy-to-use, and challenging. Many of these activities are very specific to rural areas (emphasis on farm animal wastes and septic tanks) and would not be as applicable in city areas. More background information would be helpful.

Solid Waste

Includes information on municipal waste management and on law and law enforcement.



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Pick Up and Deliver

GRADE LEVEL: 7-10

SUBJECT: Mathematics

DURATION: 1 class period
Optional: visitor to class or visit by class

CURRICULUM FRAMEWORK REFERENCE:
III.E.3., F.4

KEY VOCABULARY: Landfill, waste, garbage, refuse, sanitary landfill, transfer station

MATERIALS: A portion of your city map (if available), metric ruler, red and green felt tip markers, student sheet (included)

Concept

Calculating costs involved in waste collection and disposal.

Objectives

Students will be able to (1) solve word problems, read maps, determine costs and averages, and (2) list major factors that affect municipal waste management decisions, explaining the significance of each.

Background

One of the most expensive items in a city's budget is the collection and disposal of its waste material. Developing plans for an efficient operation is a major task of great importance. The major purpose of this activity is to help students become aware of a problem that affects every citizen.

Procedure

I. Your Town, U.S.A.

  A. Invite a representative from the sanitation department to speak about the operation of that department, and to explain how that operation affects every citizen.

  B. Option: Have a few students interview the sanitation representative in person.

  C. Option: Have a student interview a sanitation representative by phone.

II. Your Town's Facilities.

  A. Arrange for students to visit the local sanitation garage, sanitary landfill, and/or transfer station, so that the students can better understand what happens to all the waste discarded and the magnitude of the problem.

  B. Option: If a class field trip is impractical, have a few students go to the facility and report their findings to the class.

III. The "Cost"

  A. Using data from your city or county department of sanitation and the population data for your city or county, find the following:

    1. The number of households in your city or county, assuming that each household has an average of 3.4 family members.

    2. The average number of pounds of household waste produced by each person in a month. Compare with a national average of 3.4 lbs per person per day.

    3. The number of pounds of waste produced by an average household in your city or county per month.

  B. Using a map of your city or the map of Anytown, U.S.A., included in this activity, have students measure to determine the shortest route for collecting garbage from all homes and for disposing of it in the nearest landfill.

    1. Use the scale provided on the map.

    2. Assume that all waste material could be collected by one truck in the portion of the city shown on the map.

  C. Assume that two refuse trucks are used to collect solid wastes in your city (or Anytown, U.S.A.).

    1. Use a red marker and a green marker to show the shortest route for each truck.

      a. Divide the town as evenly as possible between the two trucks.

      b. The trucks may collect waste from both sides of the street on all streets (except Main Street, if using provided map).

    2. Find the distance each truck travels. Use the scale shown on the map.

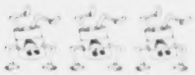
  D. Allowing for stops, assume that the cost of collecting solid wastes is $1.2 per mile within town. The cost of one trip to the landfill is 85 cents per mile. (Have students work in pairs and use the map. If you are using your own city map, mark the location of your landfill.)

    1. Determine the cost of collecting and disposing of the refuse in your city (or Anytown, U.S.A.) using two trucks.

GREAT

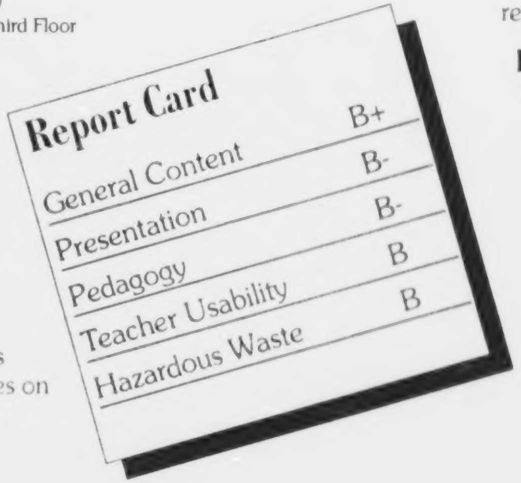
GREAT

(Groundwater Resources and
Educational Activities for Teachers)



Developed by:
Iowa Department of Natural Resources
Distributed by: ERIC Clearinghouse
for Science, Mathematics, and
Environmental Education
The Ohio State University
1200 Chambers Road, Third Floor
Columbus, OH 43212
(614) 292-6717

Call for availability and
price information.



Report Card	
General Content	B+
Presentation	B-
Pedagogy	B-
Teacher Usability	B
Hazardous Waste	B

A six-unit, science-based curriculum dealing with groundwater protection in Iowa, including the impacts of hazardous wastes and substances on groundwater.

Grades 7-9.

Comments

General Content

Challenging and science-based; a great groundwater curriculum.

Presentation

The artwork and graphics are excellent throughout this curriculum; easily reproducible by teachers and students.

Pedagogy

Most of the lessons are paper/pencil activities.

Teacher Usability

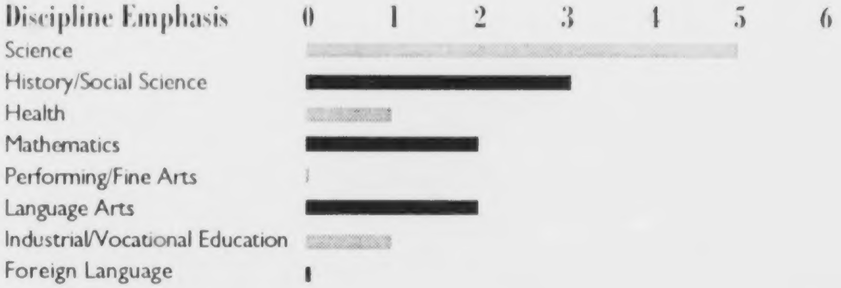
Good ideas - very well done and comprehensive. Includes an extensive resource list and good overhead materials.

Hazardous Waste

Even though this curriculum is about groundwater, it contains some good material on hazardous waste; however, some hazardous waste concepts are completely missing. Great information on leaking underground storage tanks.

Additional Teacher Thoughts

Great agricultural information and activities; however, this curriculum may be too region-specific (Iowa) to be useful in other parts of the country.



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Household Hazardous Materials

Earth/Life Science 2 Class Periods

Quick Summary:
Students will construct and use a Household Hazardous Waste Wheel to survey the hazardous materials in their homes as well as determine the harmful effects, proper disposal, and non-hazardous alternatives.

Objectives: Upon completion, students will be able to:
1. Construct the Household Hazardous Waste Wheel (HHWW) following a printed set of directions.
2. Use the HHWW to locate and identify hazardous materials in the home.
3. Identify ingredients from product labels and determine the health effects.
4. Compare label use and cautions to immediate hazard effects listed on the HHWW.
5. Compare label disposal directions to the type of disposal recommended on the HHWW.
6. List the appropriate safety measures to follow in storing and using hazardous products.
7. Evaluate the dangers of using and disposing of hazardous products in terms of a safe alternate use.
8. Describe the harmful effects of improper disposal on the environment.

Materials:
Glue
Manila folders (2 per student)
Brads (1 per student)
Scissors (1 per student)

Printed/AV Materials:
Letter to the Parents
Worksheets: Household Hazardous Waste Wheel patterns and construction directions
Household Hazardous Materials Investigation
Household Hazardous Materials Inventory form
Overhead: How Toxicants Are Absorbed By The Body
Teacher Information:
See fact sheets: Toxicants in the Body
Household Hazardous Materials (2 pages)
Unsafe Hazardous Waste Disposal Practices
See Appendix G: Potential Hazards of Household Products Classified to Chemical Type

*****Safety*****
When students are doing the Household Hazardous Materials Inventory, parent or guardian supervision is recommended. Students should not open containers, should return containers to child-proof storage areas, and should wash their hands when finished handling the containers. If you did not send the letter to the parents at the beginning of this module, a letter at this time is recommended.

Procedure:
1. Distribute the HHWW patterns and directions along with materials needed to put the wheels together.

2. When the students have completed construction, demonstrate the proper use of the wheel. It would be helpful to have some samples of hazardous household products in the classroom.

3. Discuss terms used on the wheel such as toxic and corrosive and discuss how these products cause us harm. See fact sheet Toxicants in the Body. Use overhead How Toxicants Are Absorbed by the Body.

4. Distribute Household Hazardous Materials Investigation and Household Hazardous Materials Inventory form. To show students how to fill out the inventory form at home, use a sample hazardous product and fill in the columns together using an overhead or chalkboard. As this is done, discuss label requirements and precautions. Refer to fact sheets Household Hazardous Materials. Allow the students two to three days to complete the form at home.

5. On the inventory completion date, discuss some of the results. From discussion or access to Appendix H. Potential Hazards of Household Products Classified to Chemical Type, have students determine other health hazards. Warnings and precautions on the fact sheet may give students a clue to health hazards.

6. Discuss the feasibility of some of the alternatives in light of the health hazards of given products.

7. Close by finding out student ideas about what usually happens to the products when people no longer want them. How could such types of disposal harm the environment, especially groundwater? Refer to fact sheet Unsafe Hazardous Waste Disposal Practices.

Note—Inventory forms will be most effective if taken back to the student home for future family reference.

Alternate: Worksheet: What's in a Label?

Extensions:
1. Create a poster using an ad for a hazardous household product. Included on the poster should be the ad itself, how the product is harmful, what kind of advertising persuasion is used to appeal to the consumer, how the consumer can avoid or reduce the hazards, a description of a less toxic substitute, and information about proper disposal.
2. Create an ad for a safer substitute (T.V., newspaper, magazine, or radio).
3. Create a poster, brochure, or commercial to encourage proper use of hazardous materials, proper disposal of such hazardous products, and/or the use of safer substitutes.
4. Investigate how hazardous materials can enter our groundwater when poured down drains, toilets, sewers, and/or septic tanks. This may include a diagram of the path followed.

Reference:
Adapted from Household Hazardous Waste Wheel and Household Hazardous Waste Curriculum. Environmental Hazards Management Institute.

Household Hazardous Waste

Household Hazardous Waste
How It Fits Into Your Curriculum

Town of Yorktown
Yorktown Town Hall
363 Underhill Avenue, P.O. Box 703
Yorktown, NY 10598
(914) 962-5722 Linda Cooper

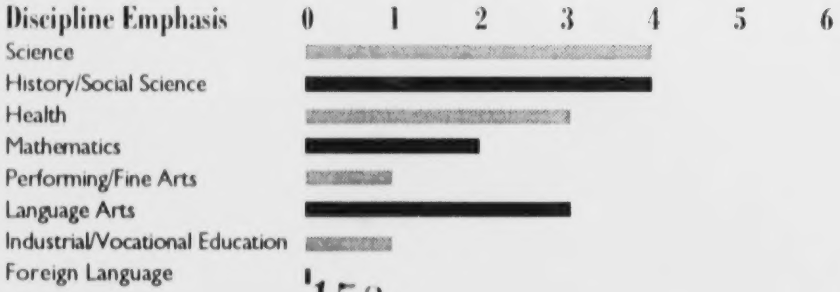
Call for cost information.

An anthology aimed at middle and high school students, and divided into seven sections: Groundwater, Household Hazardous Waste, At School, At Home, At Work, Health Effects/Alternatives, Ecology, and Stewardship. 378 pages, 1992.

Grades 6-12.

Report Card

General Content	B-
Presentation	C+
Pedagogy	B-
Teacher Usability	C+
Hazardous Waste	A-



Comments

General Content

The activities (many of which are very good) seem to be just thrown together and are not logically connected. It is difficult to determine what disciplines apply to each lesson; although topics are discussed from a science viewpoint, most student activities are social studies oriented.

Presentation

This is an accumulation of material from other guides; therefore, different formats are used. Much of the material is poorly copied and would not reproduce well for student use. There is too much emphasis on "vocabulary for vocabulary's sake."

Pedagogy

Contains good activities to stimulate social awareness and individual responsibility. Materials are heavy on reading for information.

Teacher Usability

Great background information, with a fairly comprehensive resource list. Teacher usability depends on which activities were copied from which source.

Hazardous Waste

Fully explores hazardous waste topics, including laws and groundwater issues.

Additional Teacher Thoughts

"Students can fully learn the impact of improper waste disposal and actions they can take to deal with hazardous waste responsibly."

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2. *Mapping the Territory*

ACTIVITY: Small group survey of school chemicals
MATERIALS: Map, permission to talk to teachers and students around school
TIME: Two periods

If your students are anxious to apply their new awareness of hazardous chemicals and wastes used and generated by their school, they will need to complete a survey first. This activity will help students systematically determine the chemicals and policies in their school.

OBJECTIVES:

- Students will brainstorm a list of potential sites for toxic chemicals and hazardous wastes in their school.
- Students will analyze the most appropriate ways to find out information that might be of a sensitive nature.
- Students will develop group and communication skills.
- Students will research information about the chemicals they discover.
- Students will use the standard school policies about ordering, storing, using, and disposing hazardous chemicals to evaluate their effectiveness.

TEACHER PREPARATION:

1. This activity is not appropriate for every class, every school, or every department. Think carefully about your school and your teaching colleagues. Should you modify this activity to look only at one component of the school? Check with the teachers in the department to obtain their cooperation before introducing the idea to your students.
2. Read over Activities 5 and 6 in Unit 5, ***How Do Others Feel?*** and ***Community Sensitivity*** and modify them to fit your situation. They should help your students develop a sense of asking the right questions and not playing investigative reporter or FBI!

CLASS ACTIVITY:

1. Make sure the students in your class understand the potential hazards associated with the ordering, storing, using, and disposing of hazardous chemicals in the school. Use the ***Five Scenarios*** activity and information on Groundwater, Landfills, and Wastewater Systems if the students need more information.
2. Ask your class to brainstorm a list of all the possible places hazardous chemicals may be used or stored in your school. Don't forget the vocational classrooms, the custodian's closet and maintenance shop, the art room, and the science labs.
3. If possible, have the class divide itself into small groups to survey each of these areas in your school. They should prepare to go on a mission to collect information, not to change opinions or practices (for now, at least). Do chemicals appear well labeled and organized? Is the purchase date legible? Are directions for emergencies apparent and easy to follow? Do students have access to these chemicals?

   You may have an art major who would feel very comfortable tackling the art room, for example, and would know enough about the containers to do the job quickly. You may not have access to the entire school, like the chemistry storeroom, for instance, but that shouldn't matter. Use your best judgment, and help the students project the consequences of this survey so that they practice making realistic, common sense decisions.

   As the students discover certain chemicals and question their toxicity, introduce the Material Safety Data Sheets. One is included in this activity as a guide. These sheets should be sent with every order of hazardous substance directly from the company. They are an excellent reference to the chemical nature of the substance and its safe storage, handling, and disposal. Most of the students' questions should be answered from these pages.
4. For each area of the school, have the groups ask the teacher or staff person who works there about the policies or standard practices that govern how the hazardous chemicals are ordered, stored, used, and disposed. Have they developed a formal system? Does one teacher handle everything that is hazardous? Are the students allowed to use the materials? Is their training adequate? How often are the wastes disposed? Is there something that the teacher/staff person would like to change about this policy?

   OPTIONAL: Depending upon the school, you may feel more comfortable asking one teacher who has responsibility for hazardous substances to come into your class to describe the procedure used in their department. If this teacher would like to change the practice, he or she may enlist the energy and support of your students.
5. With the information the students have collected, lead a discussion that covers each area of the school. You may wish to use a map of the school to illustrate areas with no chemicals, low concern, medium concern, and high concern. Students can define "concern"! Review their data and analyze the effectiveness of school policies. What recommendations could your students make for your school?

FOLLOW-UP:

The recommendations your students have formulated could be pursued: would they like to see to see them implemented? Unit 3, the **Community Action Project**, provides a set of guidelines to help you and the students develop a project and take action to improve the issues they identified with hazardous chemicals in their school. Skip directly to Unit 5 and use the most appropriate steps and activities for your new project!

The EarthTime Project

The EarthTime Project
Environmental Education Program

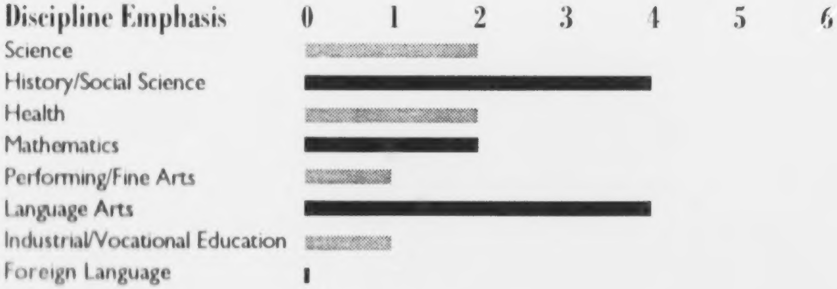
P.O. Box 1111
Ketchum, ID 83340
(208) 726-4030 Dean Paschall

Call for cost information

A student-directed activities guide wherein students, faculty and staff are brought together to address seven environmental concerns inherent in every school: energy conservation, water conservation, landscaping and gardens, waste management and recycling, chemical products use, food systems, and pesticide management. Published in 1993; however, a new version is set for release in June 1993. Translation into several languages is planned.

Report Card	
General Content	B+
Presentation	B+
Pedagogy	A-
Teacher Usability	C+
Solid Waste	C-
Hazardous Waste	D+

Grades 7-12.



Comments

General Content

It has great potential for developing community awareness and active, productive, aware members of society. Students are given the opportunity to personally change their environment.

Presentation

Guidelines are easy to follow and tailored to student understanding. Activity structure and information layout are excellent. Lessons tie in community and parents.

Pedagogy

Empowers students and contains great environmental projects for students to implement. Lessons skip experimentation and go straight to observed conclusions without testing. Teacher provides guidance rather than directives; student leadership is especially strong. "This is on the front line of hands-on, experiential education."

Teacher Usability

It would be very difficult to integrate in an established curriculum. Assumes a lot about teacher's knowledge or ability and students' access to information. It could use more teacher background or student extension materials. It has a nice appendix. "This is a good student-oriented curriculum but a poor teacher's tool."

Solid Waste and Hazardous Waste

Because these materials are student-directed, most specific content material is not included in the curriculum itself.

Additional Teacher Thoughts

"Unique!!! I feel this approach to education is challenging and has great potential." "Many educators may not have the skills or desires to allow students the freedom to make this work successfully."

SESSION II: It's The Waste Train, Elaine

Objectives

- To determine what areas of your school produce wastes and what types of wastes are produced.
- To develop a system for collecting and analyzing the waste your school produces.

Instructions

1. **Boz**, ask the class to name every location where waste is produced and what this waste is. **Class Recorder**, go to the blackboard and list the class responses. Stop reading and do this now.

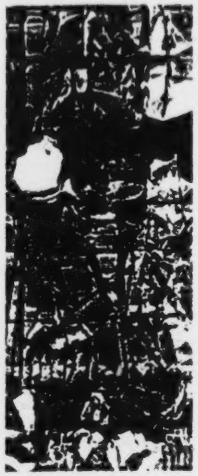
2. Next, organize these areas into related groups and give each group a heading or title. Examples of headings might be School Grounds, Bus Garage, Administrative Offices, Classrooms, Cafeteria. Try to consolidate the areas into 4 to 6 groups (depending upon how many students you have in your class).

3. **Boz**, now have the class divide into the number of groups that have been created. There are no rules about who joins which group, but the number in each group should be equal. Each group will assume the responsibility for research under that heading and will stick with their group throughout the program. Boz and **Class Recorder**, you join groups too. You don't want to miss out on the fun.

4. **Class Recorder**, write the names of the groups and their members down on paper for future reference.

5. After the groups have been established, each group select:
   - a ***Chairperson*** to be responsible for organizing group meetings and making sure the group has all the material needed for a given exercise;
   - a ***Group Recorder*** to be responsible for keeping a record of group ideas, questions and answers, and the maintenance of the group's file;
   - a ***Group Spokesperson*** to present the group's ideas.

7. Now let's get to work. The first activity is to develop a plan to collect and store the trash for each area for the next two days or one week (depending on how much stench you think you can live with). The purpose of this exercise is to identify, in visual terms, the trash produced by your school. (You really have to do a good job with this activity. If you don't, your whole EarthTime Recycling effort will fall apart!)



8. Save all the trash — EVERYTHING! Save stuff that is normally throw down the drain, or garbage disposal; oil, chemicals, everything! It is your responsibility to figure out the collection method for your area, so get to work. This will establish your baseline for the amount of trash your school produces.

9. Save the last few minutes of class time to read over the ***Post-Class Instructions*** and ***Tonight***. Then, see ya!

Tonight

("Tonight" is an alias for homework - but it's still fun, so do it)

Discuss recycling with your family. Go over the ***Reduce - Reuse - Recycle*** handout with them tonight.

And, be prepared to gather together any special materials that you may need for your group plans of stockpiling waste; i.e. garbage bags, containers for liquids, etc. Be sure to bring these items to your next session of EarthTime.

Post-Class Instructions

Boz, get in touch with the head of maintenance and explain your project to him/her. Explain that your first activity is to collect all the waste from the entire school for a designated period of time. Make sure s/he notifies the sanitation pick-up guys.

Also, run off enough copies of ***What Can We Recycle?*** for every student for next session.

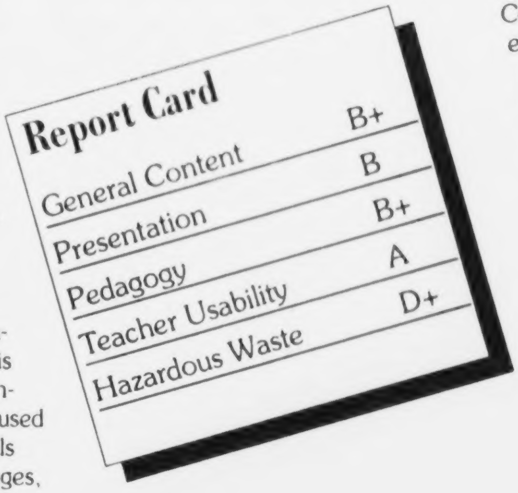
Investigating Hazardous Materials

Investigating Hazardous Materials
SEPUP (Science Education for
Public Understanding Program)
Lawrence Hall of Science
University of California, Berkeley
1 Centennial Drive
Berkeley, CA 94720
(510) 642-8718

$175, includes materials
for 160 students.

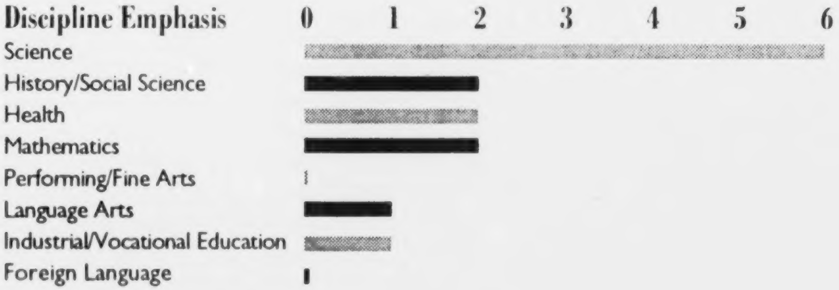
SEPUP is a diverse educational program highlighting chemicals and their uses in the context of societal issues. In this module a simulation involving a drum containing mixed waste is used to introduce concepts and processes used in hazardous materials identification. 90 pages, 1993.

Grades 7-9.



Report Card

General Content	B+
Presentation	B
Pedagogy	B+
Teacher Usability	A
Hazardous Waste	D+



Comments

General Content

This is a good way to introduce toxic substances in a chemistry/science class. It brings real-life situations to the science class.

Presentation

Could use wastes from one lab as raw materials for the next to model environmental responsibility.

Pedagogy

The learning is fun, constructivist, and open-ended. Good lab activities that could be opened up to provide more of an inquiry approach. As it stands, the labs are too "cookbook." Little use of decision trees.

Teacher Usability

Limited listing of resources.

Hazardous Waste

Very specific to the chemistry of identifying hazardous materials. This would need to be used with other SEPUP modules (such as "Toxic Waste - A Teaching Simulation") to be more subject-comprehensive. Opens up other areas not specifically covered (in this evaluation).

Additional Teacher Thoughts

"Great!" Some of the activities sound like CAP test questions.

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Name *Date* *Period*

STUDENT SHEET 1·1

Recognizing Hazardous Substances

Purpose

You will examine the container of simulated hazardous waste and describe the contents. At home, you will examine items for materials that may be hazardous, and consider methods of proper disposal of these hazardous substances.

Procedure

Read the background information and answer the questions. You will need to take this sheet home to complete it.

Background information

Substances whose chemical or biological nature makes them potentially dangerous to living things are called hazardous. They may be capable of causing injury or even death. The chart shows 4 major categories of hazardous substances:

Safety notes: *Use caution when handling all hazardous substances, whether in school or at home. Notify your parents of this assignment, as directed by your teacher.*

Flammable	Can serve as fuel for a fire (gasoline, kerosene, paint thinner)
Corrosive	Can eat through metal or skin—strong acids or bases are good examples (pool or battery acid, ammonia, drain cleaners).
Toxic	Can cause short term (acute) effects such as poisoning or a rash, tears, choking or vomiting, or might have other long-term (chronic) effects on health (lead, asbestos, mercury, pesticides).
Reactive	Can cause an explosion or provide heat or oxygen that might cause a fire, or can emit toxic fumes when mixed with other substances (ammonia-based cleaners and bleach emit toxic fumes when mixed). Some substances, like acetone (fingernail polish remover), belong to more than one hazard category—acetone is flammable and toxic if accidentally inhaled or ingested.

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STUDENT SHEET 1·1 (CONTINUED)

Questions

1. Examine the container of simulated hazardous wastes. Describe the contents as completely as you can.

____

____

____

Take this sheet home. Examine various rooms in your home for common materials you think may be hazardous. Record the indicated information for at least five of these items in the space below. The main ingredients can generally be found on the item label.

Hazardous materials in the home chart

Item name	Main ingredients	Type of hazard (flammable, corrosive, toxic, reactive)

2. How would you normally dispose of these materials?

____

____

____

3. What are the instructions on the label of one or more of these materials for PROPER disposal?

____

____

____

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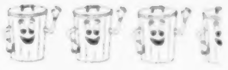
Florida 4Rs Project

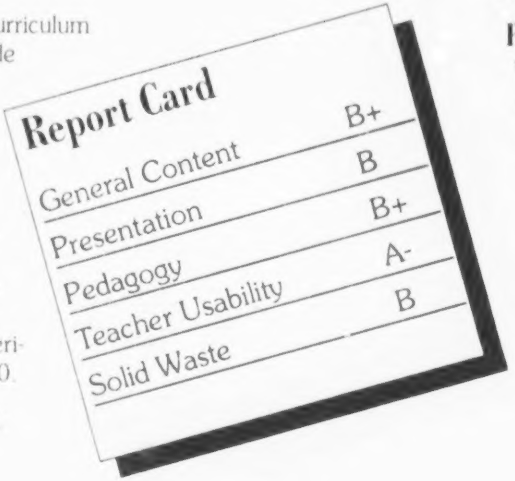
Florida 4Rs Project
Florida Department of Education
Educational Materials
Room B1 Collins Building
Tallahassee, FL 32399-0400
(904) 487-7900 Melvyn Lord

$4.50



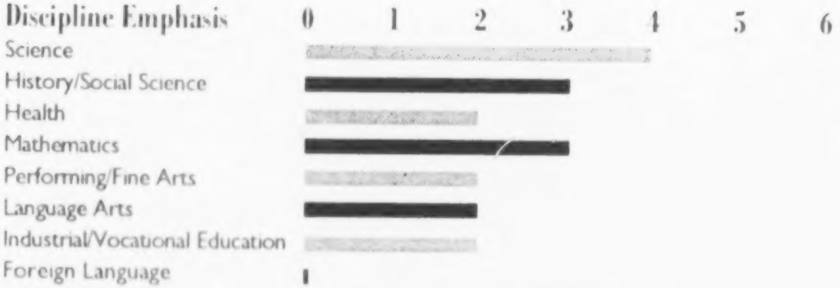
An anthology-type curriculum divided into four grade level packages (preK-3, 4-5, 6-8, 9-12). Each package contains a Florida-specific general introduction, a set of individual lessons and blackline masters, and other student learning materials. 236 pages, 1990.

Grades Preschool-12



Report Card	
General Content	B+
Presentation	B
Pedagogy	B+
Teacher Usability	A-
Solid Waste	B

Discipline Emphasis



Comments

General Content

This group has developed an in-depth, thorough, interdisciplinary curriculum that will really work in science classes. Great incorporation of energy processes throughout. Needs updating, still uses USSR and West Germany.

Presentation

Very clear in scope and design, with good print and graphics. Very community oriented. Some materials are too elementary for high school, but others are quite good.

Pedagogy

High level, challenging activities with good action suggestions; however, there are not enough experiments. Includes sound evaluations. Information depends a lot on what students dig up, which is good, but teacher needs support materials to be able to supplement.

Teacher Usability

Well-organized and comprehensive; however, a matrix by subject area would be useful. Activities are well-defined and outlined and easy to use individually. The limited background information is Florida-centered; a California teacher needs to do some modification/adaptation. Includes a good glossary and a Florida-specific resource list.

Solid Waste

Fails to stress the importance of purchasing recycled products. Incorporates a few lessons on hazardous materials.

RUNNING OUT OF RESOURCES

Grades: 9-12
Subjects: earth/space science, geography, environmental science
Skills: analyzing, comparing, discussing, identifying, interpreting, listing, predicting
Group Size: whole class, individual
Setting: classroom
DOE Performance Standards: science-A33, J276, K282, K285, K286, K287, K288, K289, *A1052, B1077, B1078, B1080, G1392, J1480, K1488, K1494, K1499, K1501, K1503, K1505*
4Rs Framework: I.B.1, I.B.2, I.B.3, I.B.5, I.D.3, II.B, IV.A.1
Vocabulary: raw materials, Btu, renewable, nonrenewable, resource
Time: 1 period

Objectives Students will: (1) describe how energy supplies can affect the manufacture of different products, (2) identify the United States as the prime consumer of nonrenewable resources, and (3) describe the effects of increased consumption and population growth on depletion rates of nonrenewable resources.

Method Students review the raw materials used in the manufacture of products and examine data regarding the geographic sources and life expectancies of nonrenewable resources.

Background Resources are materials or forms of energy that can be used to make other materials. Resources can include raw materials, man-made materials, and recycled materials. Raw materials (like iron ore or trees) are obtained from the natural environment. Raw materials are usually the starting materials for a manufacturing process. Man-made materials (like steel or lumber) are materials or products that have been processed or altered in some way and are no longer in their natural or original state. Man-made materials can be manufactured from raw materials or recycled materials. For example, glass bottles can be made by mixing and heating sand, soda, and lime or they can be made by melting and reforming used glass bottles.

Resources used by humans can be classified as renewable and nonrenewable. Renewable resources are those which can be replaced over and over again. With conservation and proper management, renewable resources such as solar energy, water, and trees can last indefinitely. Nonrenewable resources such as iron ore, bauxite ore, and natural gas cannot be replaced. The earth only contains a finite or limited supply of nonrenewable resources.

As a result of advances in manufacturing technology, population growth, and increasing consumer demands, the consumption of nonrenewable resources has steadily increased in the past four decades. If current trends continue, global supplies of many nonrenewable resources, including aluminum, iron ore, lead, tin, natural gas, oil, and uranium, will be depleted within the next century.

Potential desirable strategies for extending the life expectancy of valuable nonrenewable resources include using recycled materials rather than raw materials in the manufacturing process whenever possible, substituting products made from renewable resources for products made from nonrenewable resources, and reducing consumer demand for products made from nonrenewable resources. A less desirable strategy for extending the life expectancy of nonrenewable resources consists of developing new technologies to obtain and use supplies of resources that are currently difficult and/or expensive to acquire (such as mineral supplies in environmentally sensitive areas like Antarctica). Consumers need to consider their personal rates of consumption and identify ways they can help stem the depletion of nonrenewable resources.

WORKSHEET

ENERGY AND RESOURCES

Part 1

Energy requirements using *raw materials* for manufacture:

Paper	20,373 Btu/lb
Glass	7,611 Btu/lb
Steel	14,778 Btu/lb
Aluminum	98,560 Btu/lb
Plastic	18,532 Btu/lb

Energy savings using *recycled materials* for manufacture:

Paper	30-55%
Glass	8-32%
Steel	47-74%
Aluminum	95%
Plastic	60-70%

1. Which industries will be hard hit in the next energy crisis? Why? ______________

2. In what two ways would the plastics industry be affected if oil prices rose sharply? ______________

Part 2

NONRENEWABLE NATURAL RESOURCES:

Life Expectancies and Prime Consumers

Resource	Reserve Base	Countries or Areas with Highest Reserves	Prime Consumers	Life Expectancy in Years	
				Static Use at current level	Use growing at projected rates
Aluminum in Bauxite	23.2 billion metric tons metric ton= 2,200 lbs	Guinea 25% Australia 20% Brazil 13% Jamaica 9%	USA 42% USSR 12%	312 years	63 years
Iron in Ore	98 billion short tons short ton= 2,000 lbs	USSR 26% Australia 21% Brazil 11% Canada 10% S.Africa 7% USA 6%	USA 28% USSR 24% West Germany 7%	172 years	62 years
Lead	142 million metric tons	Australia 20% USA 12% Canada 10%	USA 25% USSR 13% West Germany 11%	37 years	25 years
Tin	4.2 million metric tons	Malaysia 26% Indonesia 16% Brazil 15% China 9%	USA 24% Japan 14%	41 years	31 years

3. List the prime consumer of each resource. Aluminum: ______________

Iron Ore: ______________ Lead: ______________ Tin: ______________

4. If consumption grows at projected rates, which resource will be the first to be depleted? Next? List in order. Next to these, list how old you will be when the resource is depleted.

1. ______________ 2. ______________

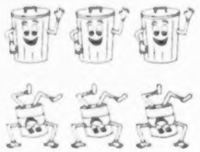
3. ______________ 4. ______________

Closing the Loop

Closing the Loop

Integrated Waste Management
Activities for School and Home

The Institute for Environmental Education
18554 Haskins Road
Chagrin Falls, OH 44023-1823
(216) 543-7303 Mary Chadbourne



$32 for K-12.
$28 for K-8.
$26 for 9-12.

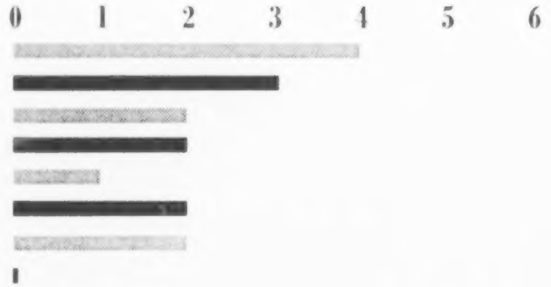
A collection of activities grouped under three thematic sections: Everything Ends Up Somewhere, We Have Options And We Make Choices, and Everything Is Connected. Activities are intended to be hands-on, problem-centered, practical, and adaptable across grade levels and subjects. 1991.

Grades K-12.

Report Card

General Content	A-
Presentation	B
Pedagogy	B
Teacher Usability	B+
Solid Waste	A-
Hazardous Waste	B-

Discipline Emphasis



Comments

General Content

Nice flow of topics and thoughts in cohesive units. Very student/school/community- involvement oriented. Lab activities relevant. Great interdisciplinary ideas.

Presentation

Confusing page numbering system. Quality diagrams for several good experiments. Printed on recycled paper.

Pedagogy

Instructional materials are for direct use by teachers, not students.

Teacher Usability

Concise, well-organized, and usable as individual activities. All age level activities are mixed into one book. Good table of contents, which includes a brief description of activities. Access would be easier if segregated by grade groupings. Grade level and subject matter matrices would be helpful. A resource list is found at the end of each activity, and a glossary at the end of the book. Reproducibles are easily located.

Solid Waste

Good solid waste information, but does not complete the recycling loop. Good composting activities, which include food chain roles. Waste audits need to address health issues.

Hazardous Waste

Limited hazardous waste information.

Additional Teacher Thoughts

"Super curriculum!"

PLANNING YOUR RECYCLING PROGRAM: A LOOK AT THE DEMOCRATIC PROCESS

Grades: 5-8 & 9-12

Subject: Social studies, language arts

Format: One class period

VOTE TODAY
FOR RECYCLING
COORDINATOR!

OBJECTIVE: To teach students about the democratic process, while at the same time involving them in the planning of the school recycling program.

METHOD: Students elect one of their peers to assist faculty and administrators in planning and implementing the school recycling program.

BACKGROUND: For years, planning committees have been used by government and private industry to develop and implement important projects. Such committees are often composed of representatives from the various parties affected by the program. Together, these representatives set goals for the project, develop a plan for implementation, assign specific tasks, keep the project on schedule, keep costs down, and work to resolve any problems that arise.

A planning committee organized along this general model is critical to developing a successful recycling program in schools. In order to be effective, such a committee must include teachers, administrators, parents, maintenance staff, food service personnel, grounds workers, and students. The task of this group is to guide the recycling program through its various stages of development. A recommended procedure is outlined in the IEE Administrator's Manual. (See the end of this activity for the eight steps and their description.) Teachers should contact the school recycling coordinator in order to find out the exact composition and duties of the planning committee.

C. What can they do in real life if they are not happy with their representative? Ask students to think of examples from actual political life (recalls, impeachment, letter-writing campaigns, etc.).

D. Did they learn anything about the democratic process that they didn't know, understand, or appreciate before? If so, what?

More broadly based discussion about government and representation is relevant to explore as well:

E. Why do so few people vote in national elections in the U. S. when people in other countries are willing to die for the right to vote?

F. Why do many Americans feel estranged from the democratic process?

G. What does it take to re-empower people?

H. Do we have a duty to participate in the democratic process?

I. What does it take to be a responsible citizen in a democracy?

VARIATIONS: This activity can be as simple or complex as the teacher wants. Instead of electing a permanent representative who plays an on-going role in the planning process, younger classes could elect a student to sit in on one meeting and then report back to the class.

Older students could compare and contrast their recycling committee representative system with the American system as it now stands. How accurate an approximation is it? How can it be improved?

FURTHER STUDY: Ask students to research an environmental issue that is being debated in Congress and then write a letter to representatives and senators. Some useful tips on writing effective letters include the following:

A. Keep the letter short and to the point. Try not to exceed one page at most;

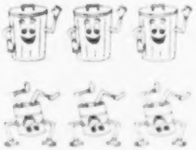
B. Address the letter to the representative or senators in your district or state (For mailing information, call the White House at (202) 456-1414, the U.S. House of Representatives at (202) 225-3121, and the U.S. Senate at (202) 224-3121); and

A-Way with Waste

A-Way with Waste
(3rd Edition)

Washington State Department of Ecology
3190 160th Avenue, S.E.
Bellevue, WA 98008-5452
Attn: Jan Lingenfelter
(206) 649-7043

$28.50



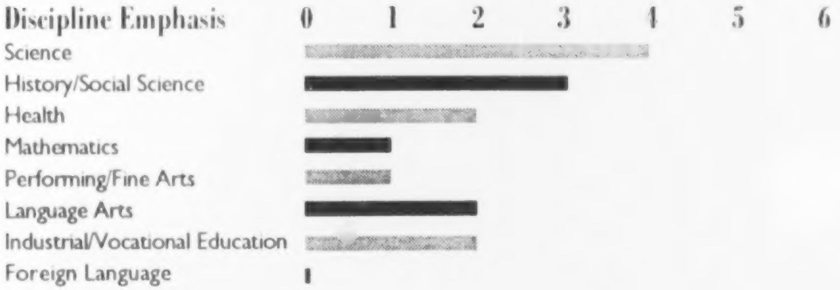
This curriculum is written and organized to present integrated waste management concepts affecting land, air, and water in the ecosystem. The activities are designed to promote awareness, attitudes, and actions to solve waste management problems at home, in school, and in the community. 570 pages, 1990 (an updated version set for release in September 1993).

Grades K-12.

Report Card

General Content	B+
Presentation	B-
Pedagogy	B
Teacher Usability	B+
Solid Waste	B-
Hazardous Waste	B

Discipline Emphasis



Comments

General Content

Thorough and exhaustive curriculum with many relevant activities. Provides a nice, easy integration of topics as they apply to hazardous materials and solid waste.

Presentation

Incorporates good graphics in a good layout. Printed on recycled paper. "Love the concept charts in the beginning."

Pedagogy

Most reference materials, worksheets, and instructions are teacher (vs. student) oriented. The teacher is the provider of factual information, thus scores on content may be lower than the actual information available in this curriculum. One of the few curricula that demonstrates sensitivity to diversity. Some activities are uninteresting "busywork."

Teacher Usability

Excellent topic organization makes this material "teacher/kid-friendly." Separation of elementary and secondary lessons would save bulk and paper. Lab instruction sheets are ready to copy and hand out. Includes a bibliography and glossary, and lesson-specific resources appear at the end of each topic.

Solid Waste

Does not emphasize "closing the loop;" fails to stress purchase of recycled products.

Additional Teacher Thoughts

It would be preferable to divide this into separate curricula (for example, K-6, 7-9, 10-12).

Garbage: Its Possibilities!

Subjects: Social Studies, Language Arts
Grades: 10-12
Teaching Time: Two Class Periods
Focus: Solid Waste Management, Recycling, Public Opinion

Rationale

Refuse should be considered a resource, not a liability

Learning Objective

Students will

- Investigate the solid waste management plan in their community
- Submit a plan to the city council which includes recycling as part of the garbage collection policy

Teacher Background

Contact your city or county planning department for information regarding your local solid waste management plan

Pre & Post Test Questions

1 What is a resource recovery plant?

2 How much does your family pay for garbage collection and disposal?

3 What happens to your family's garbage after it leaves your house?

Learning Procedure

Each student will do the following

1 Research the solid waste management policy in his or her own community and compare it with surrounding communities. Is garbage collection mandatory? What is the cost to individual homeowners for garbage collection? Is recycling encouraged or discouraged?

2 Develop a questionnaire that will be used to interview people in the community concerning their feelings and ideas about present and future alternatives to garbage collection.

Sample Questions

- Do you know what happens to your garbage?
- Do you recycle?
- If you could get a lower collection rate for reducing the amount of garbage your generate would this motivate you to recycle?
- Which of the following solid waste management options do you favor in dealing with this community's solid waste
  - Reduction
  - Recycling
  - Resource recovery plants
  - landfills
- Do you see any other options for solid waste management in your community?

3 Interview 10 to 15 people in the community to determine their solid waste management preference and graph the results.

4 Using the results of your garbage poll, write a letter to your city decision makers describing the feelings of the people in the community towards present garbage collection policies and some possible improvements that would include recycling

5 Use the results of this questionnaire in planning a school recycling program

---

Resources - *See the Department of Ecology resource book for materials available to use with this activity*

Brochure "A Guide to Recycling Around the House." Washington State Department of Ecology, Waste Reduction, Recycling and Litter Control Program, 1989

Bibliography

Lauber, Patricia. Too Much Garbage. Chicago, IL. Garrad Publishing Co., 1974

Peterson, Christina, et al. Energy, Food and You, Secondary Guide. Seattle, WA., Washington State Office of Environmental Education, Northwest Section, revised 1983

Pollack-Shea, Cynthia. "Building a Market for Recyclables." Worldwatch. Washington, D.C. Worldwatch Institute. May-June 1988, Vol. 1, No. 3, pp. 12-18

Pollack-Shea, Cynthia. "Realizing Recycling's Potential." State of the World 1987. Washington, D.C. Worldwatch Press, 1987

The No Waste Anthology

The No Waste Anthology
California Department of Toxic
Substances Control
P.O. Box 942732
Sacramento, CA 94234-7320
(916) 322-0476

Free.

A compilation of interdisciplinary, action-oriented, cooperative problem solving activities focusing on pollution prevention. Divided into three sections: Natural Resources and Pollution Solid Waste and Hazardous Waste. 320 pages, 1991.

Grades K-12.

Report Card

General Content	B+
Presentation	B
Pedagogy	B-
Teacher Usability	A-
Solid Waste	B-
Hazardous Waste	B

Comments

General Content

Good integration of related subjects for cross-curricular teaching. As this is an anthology, the overall flow of ideas can be easily lost from one activity to the next.

Presentation

Format, student sheets and printing are of excellent quality.

Pedagogy

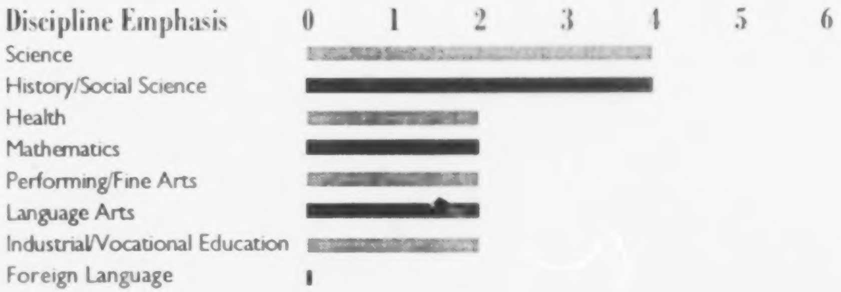
Lots of cooperative learning, but activities are not challenging enough at the high school level. Lots of reading and worksheets.

Teacher Usability

Grade and subject matter appendices are provided; page numbers here would make it easier to access appropriate grade level and subject material. The resource list is limited. Lots of photocopying required.

Additional Teacher Thoughts

"Excellent, relevant, diverse activities!" "There are some super activities in this curriculum."



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HOW VERY LITTLE IT MUST BE

PROCEDURE

1. We now have the technology to measure chemicals in the parts per million (ppm) or even parts per billion (ppb) ranges. What do these terms mean?

(A part per million is a proportion in which one unit of a substance is found in a million units of surrounding material such as air, soil, or water. One part per million is proportional to one second in twelve and a half days (300 hours). A part per billion (ppb) is a proportion in which one unit per billion is measured. One part per billion is proportional to one second in 32 years.)

2. Provide students with the following information.
- Clear Lake is a 100 acre lake with an average depth of 25 feet.
- Swimming Pond covers one acre with an average depth of 10 feet.
- Deep Rock Aquifer extends over 50 square miles with an average depth of 6 feet.

Goals:
Students will
- Gain experience calculating parts per million(ppm) and parts per billion (ppb)
- Understand how proportionally small both a part per million and a part per billion are
- Understand that a very little of some contaminants goes a very long way

School Subjects:
Mathematics, Chemistry

Grades:
11th - 12th

Time:
1 class period

Drinking Water Standards

Listed below are some of the chemicals or compounds that can contaminate our drinking water with the corresponding California maximum contaminant levels (MCL) and the Federal standards.

Benzene - 0.005 ppm = 5 ppb
- 0.001 mg/l (MCL)

Arsenic, Lead
- 0.05 ppm = 50 ppb
- 0.05 mg/l (MCL)

2,4-D - 0.10 ppm = 100 ppb
- 0.1 mg/l (MCL)

1,1,1 Trichloroethane (TCE)
- 0.2 ppm = 200 ppb
- 200 mg/l (MCL)

Fluoride - 4 ppm = 4000 ppb
- 1.4-2.4 mg/l (MCL)
(depending on annual average of maximum daily air temperature)

Conversion Table

1 cubic foot = 7.48 gallons
1 gallon = .1337 cubic feet
1 acre = 43,560 square feet
1 square mile = 27,878,400 square feet

3. Using the information above, have students solve the following problems. (Answers are given in parenthesis)

A. The California Department of Health Services (DHS) investigations unit is attempting to track down the parties responsible for dumping 5 gallons of the herbicide 2,4-D in Swimming Pond. If the chemical becomes evenly dispersed what would be its concentration in ppm? (1.534) In ppb? (1,534) Should the DHS restrict access to Swimming Pond? Why?

B. The State Highway Patrol has notified the Department of Health Services that six gallons of benzene were accidentally spilled into Clear Lake. If it is evenly dispersed, what would its concentration be in ppm? (0.00738) In ppb? (7.38) Should the residents who depend on the lake for drinking water be notified? Why?

C. An old rusted, unmarked 55 gallon drum was discovered on the property of a resort near Clear Lake. Although the manager suspects it may contain a hazardous chemical, he asks his assistant to get rid of it any way he can. Calculate the concentration of contaminant in groundwater if a 55 gallon drum of the chemical were illegally disposed of in an old well and dispersed evenly throughout Deep Rock Aquifer(0.000879 ppm or 0.879 ppb)

What if the same quantity of the chemical were illegally disposed of in Clear Lake? (.0675 ppm or 67.5 ppb), in Swimming Pond? (16.9 ppm or 16,900 ppb)

D. Suppose a 5,000 gallon tank truck loaded with the chemical Arsenic ran off the highway and all the chemical spilled into Clear Lake. What would be the concentration of the chemical in the lake? (6.138 ppm or 6,138 ppb) Does this violate the federal and/or state standards?

4. Have students compare their calculation to the drinking water standards for all the chemicals listed above.

Ask: Which "incident" was the worst in terms of contamination? Which scenario(s) didn't violate any of the standards? How many of the cases violated the benzene standards? The TCE standard? etc.

5. Discuss possible ways of dealing with each of these problems. (Calling the Department of Health Services about a spill, determining civil or criminal penalties for violators, educating the public as to potential threats to human health and to fish and wildlife, restricting access to contaminated waters, developing plans to prevent similar contaminations in the future, etc.)

Adapted from **A-WAY WITH WASTE, 1990**

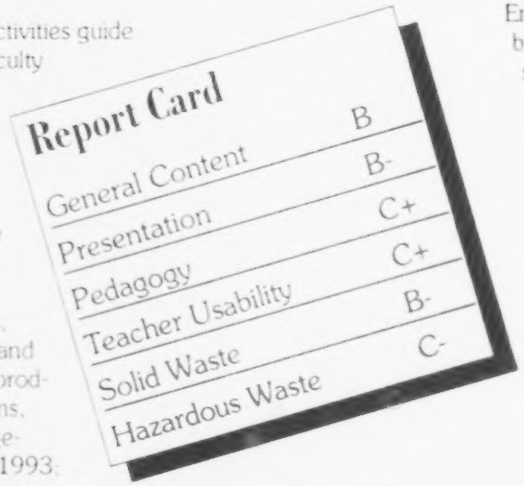
The EarthTime Project

The EarthTime Project
An Environmental Education Program

P.O. Box 1111
Ketchum, ID 83340
(208) 726-4030 Dean Paschall

Call for cost information.

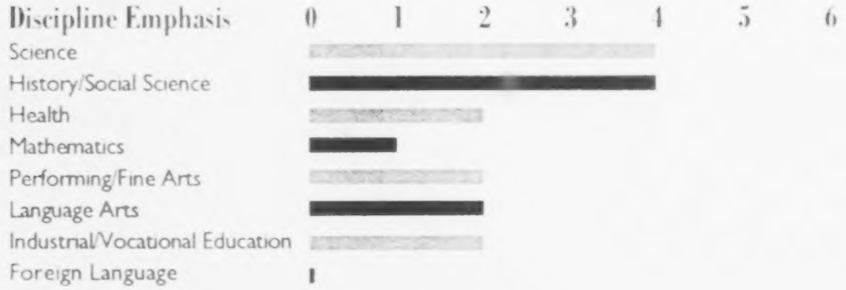
A student-directed activities guide wherein students, faculty and staff are brought together to address seven environmental concerns inherent in every school: energy conservation, water conservation, landscaping and gardens, waste management and recycling, chemical products use, food systems, and pesticide management. Published in 1993; however, a new version is set for release in June 1993. Translation into several other languages is planned.



Report Card

General Content	B
Presentation	B-
Pedagogy	C+
Teacher Usability	C+
Solid Waste	B-
Hazardous Waste	C-

Grades 7-12



Comments

General Content

Could be improved by including an outline or theme.

Presentation

Written in an interesting, humorous, readable manner with kids in mind. Emphasizes ethics. Gives students ownership in school policies, and brings in family and home participation, as well as local and global perspectives. Some industries may view some of the information as biased.

Pedagogy

Student-directed; teacher is a facilitator only, but leadership roles among students need to be spread out more. This is one of few that are sensitive to social, economic, and cultural diversity. Group activities tend to be undefined. Many activities involve "busywork" - reading and question answering.

Teacher Usability

Short on background materials for students and teachers. Well-written curriculum in which any part could stand on its own. Many ideas are not practical. Lots of photocopying required. Lacks student response sheets or evaluation mechanisms.

Hazardous Waste and Solid Waste

"This binder's scope goes beyond the traditional hazardous/solid waste content...it deals with nutrition, energy, water topics, but often as they apply to hazardous materials." More discussion of positive alternatives would be helpful. The primary focus is on home and school, not industry. Because these materials are student-directed, most specific content material is not included in the curriculum itself.

Additional Teacher Thoughts

"This curriculum would be good for a leadership class for middle school students."

SESSION II: Chemicals?

When chlorine is released into the environment, it combines with other substances to create toxic compounds such as chloroform.

(Boz, read the entire session aloud and organize any activities that occur.)

Objectives

- To determine where in your school chemical products are used.
- To formulate questions about the use of chemical products in your school.

Instructions

Note: apply your investigative efforts and thoughts to the school building, shop classes, bus garage — everything except lawns and gardens. EarthTime Pesticides will deal with chemicals used on the school grounds.

1. **Boz**, choose one of your classmates to be the **Class Recorder**. Choose someone who knows their way around a term paper.

   The Class Recorder is responsible for taking class notes and for finalizing the proposal to the Environmental Review Committee.

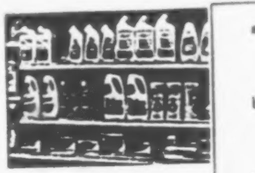
2. **Boz**, go to the blackboard and get ready to write the list of areas and chemical products thatare used in your school. **Class Recorder**, copy all this down on paper for future reference.

3. Now let's get started. Ask the class to think of each area in the school where chemical products are used. First list all the areas and then all the products used in that area. Where do the busses get cleaned and serviced? What chemicals are used in the school offices? What about wood shop and metal shop? Chemistry? Home Ec? What is used to clean the floors? How do they keep cockroaches out of the locker rooms? Does your school have a pool?

4. Having completed your list, combine some of the specific areas into broader categories so that you end up with four to six groups. For example, you could have one group for the food preparation area, another for cleaning products, another for shop classrooms, etc. Got the idea? Go.

5. Next, **Boz**, divide the class into groups to cover the areas listed on the board. Each group select one area and stay with this area for the remainder of the project. Do this now.

6. After the groups have been established, each group should select:



   a. **A Group Chairperson** to be responsible for organizing the group and making sure they have the material needed for a given exercise.

   b. **A Group Recorder** to be responsible for keeping a record of group ideas, questions and answers, and the maintenance of the group's file.

   c. **A Spokesperson** to present the group's ideas.

Boz and Class Recorder, join groups as well. You don't want to miss out on the fun. Stop reading and do this now.

7. Now groups, create a list the products you want to investigate in your area. This list might grow or shrink next session after you take a tour of the school.

8. Finally, each group is to develop a list of questions concerning chemical use in your area. You will be taking a tour of your area next session. Your "mission" is to learn all you can about the chemical products used in your area. Find out what toxins are found in each product, how these toxins affect you and the environment, and how the chemical products are stored and disposed of. It is also important to find out how these products are ordered, where they come from and how much they cost.

9. Your mission is non-confrontational. Many in the staff or administration may not have answers to all of your questions. That's OK. Remember, the only way to bring about positive, cooperative change is to work together.

Post-Class Instructions to Boz

(Yes, read this aloud too in the last few minutes of class)

In the next session, the groups will take a tour of the school. You need to contact the persons responsible for purchase and/or use of chemical products in each area and work out a good time for the tour. Let them know what your groups are interested in learning and suggest they have available samples or labels of the chemical products being used.

Boz, before the next session, make sure that you contact the maintenance staff and work out the details of when and where you will meet for the tour.

Also, make copies of the handout ***A Pesticide-Free School For A Chemically Sensitive Family In Boise, Idaho***. These will be needed for next session's homework.

Bags... Beakers... and Barrels

Bags...Beakers...and Barrels
Industrial States Policy Center
17 Brickel
Columbus, OH 43215
(614) 224-4111

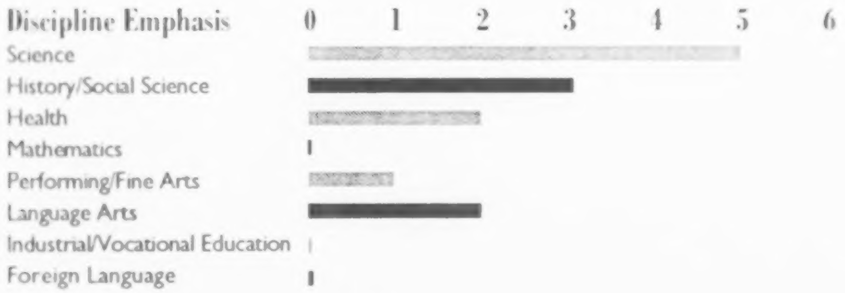
Call for cost information.

A five unit curriculum designed to help students better understand the problems associated with hazardous materials. Units progress towards completion of a community action project. 1987

Grades 7-12

Report Card

General Content	B
Presentation	B-
Pedagogy	B-
Teacher Usability	B-
Hazardous Waste	B-



Comments

General Content

Contains relevant case studies and clear cut objectives, but is weak on subject integration. Too brief in some areas.

Presentation

Interesting global case studies included, as well as good pro/con activities examining alternative views. Not an eye-catcher.

Pedagogy

Uses scientific method, but contains few actual lab experiments. Strong on communication skills, primarily metacognitive development. Emphasizes awareness and empowerment; includes group process activities and community sensitivity guidelines in the appendix. The instructions are mostly teacher (vs. student) oriented. Includes action projects.

Teacher Usability

Well-organized, clear, and concise, but needs more background information. Excellent resource section includes government, industry, and film listings.

Hazardous Waste

Lacks information on hazardous waste alternatives and waste reduction methods.

Additional Teacher Thoughts

Some individual activities are especially useful. 1987 material, ready for an update. "This would be good for a middle school leadership class."

185

186

2. Baker's Dozen

ACTIVITY: Individual reflection on the value one places on common products
MATERIALS: Paper and pencil for each student
TIME: 1 class period

Many environmental issues cannot be resolved until people understand how their behavior contributes to the problem, reflect on their values, and make an effort to change their practices. This activity will help students clarify their values about synthetic material goods.

OBJECTIVES:

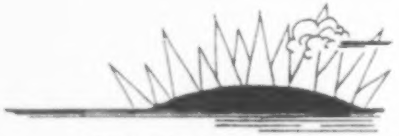
- Students will realize that consumer habits help contribute to hazardous waste problems.
- Students will contemplate the value they attach to items that are responsible for the generation of hazardous wastes.
- Students will consider altering their habits to reflect their increasing concern for the environment.
- Students will learn to listen to differing values, respecting viewpoints otherthan their own.

TEACHER PREPARATION:

1. Review the hazardous by-products generated by common items, such as those described in the Teacher Background section in the previous activity, ***Hazardous Waste Card Games***.
2. This activity will be most successful if students already feel comfortable talking with classmates about their feelings and opinions. If not, you may want to save this activity until the group has completed more group process activities, or alter it.

CLASS ACTIVITY:

1. Ask each student to list thirteen non-food items that they buy, use, or wear throughout the year on a piece of paper. Give them plenty of time to come up with their ist.
2. Now, ask them to categorize certain items on their lists:
   - Choose two things on their list that they consider to be essential necessities, and draw a line through them.
   - Draw a line under any item that is used frequently for several years, like a soccer ball or trumpet.
   - Star any item made from petrochemicals (plastic, rubber, nylon).
   - Star any item that is articially colored, bleached, or dyed.
   - Circle any item that is new to them — something that would not have been on their list five years ago.
3. Help students categorize any items that do not fall neatly into a section, or make up new categories to accomodate them.
4. Explain that most, if not all of the items on their list generate hazardous waste in their production. Knowing that they are responsible for part of the hazardous waste in the country, lead a discussion:
   - How do your students feel about their list?
   - Do they find any surprises?
   - Do they feel guilty? Angry at not having good choices?
   - Do they still need all the items on their list—are there some they might be able to do without? Are there alternatives that may not generate as much hazardous warte? Items made from natural materials or with less processing often fall into this category.
5. Ask the students to rank the underlined, starred and circled items on their list from 1 (the most important item to keep) to 11 (the least important, or easiest to replace). Ask if anyone plans to commit their concern for clean air, water, and soil to action by trying to change their habits. Introduce the idea that as long as people continue to buy these products, companies will continue to make them. It's up to us.
6. How can the class promote more responsible consumer habits amoung fellow classmates in the rest of the school?



UNNECESSARY NECESSITIES

"Civilization is a limitless multiplication of unnecessary necessities."

—Mark Twain

Now that the consumer connection has been made, how can it be resolved? The difficult choice of one product over another is often not enough. There are some additional questions we can ask.

Do I really need this product?
It is amazing how many items we can say "no" to without affecting our comfort, health, or enjoyment of life. Each person makes these decisions based on their own priorities. However, asking, "do I *really* need this?" before purchasing something will help you establish and critique your values.

Should I substitute another product for this one?
If most products generate hazardous waste, perhaps we should buy those which last longer, so that less waste will be produced. Cotton or jute shopping bags, for example, last much longer than plastic or paper. Buying goods that are less heavily packaged and buying food in bulk quantities can reduce the amount of plastic discarded. Reusable cloth towels, cleaning rags, handkerchiefs, sponges, and cloth napkins can be substituted for disposable products.

Can I use less of this product, or use it less frequently?
Since most products involve at least some hazardous waste generation, the answer may not be in purchasing another product, but in consuming less. If the label says to use one cup of laundry detergent, will two thirds of a cup do the job?

How will I use and discard this product?
What happens to this product once it is home? Is a portion wasted? Reused? Given to neighbors? Thrown away? Once discarded, does it drift into the groundwater supply? Can it be recycled, reducing the need to process more resources?

From **Hazardous Waste and the Consumer Connection**, 1984, Science for Citizens Center, and Michigan Environmental Education Association

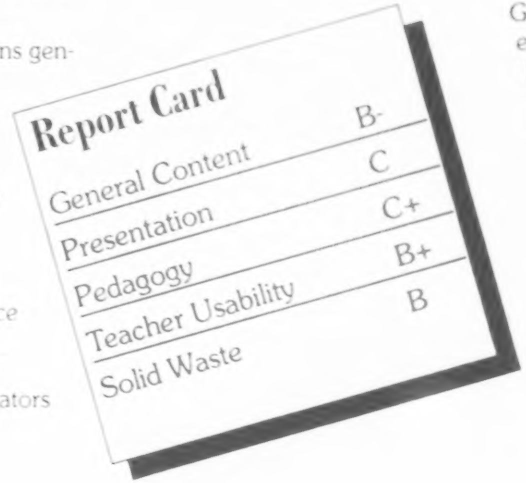
Recycle Hawaii for Kids

Recycle Hawaii for Kids
City and County of Honolulu
Recycling Office
Division of Refuse Collection and Disposal
650 South King Street, 6th Floor
Honolulu, HI 96813
(808) 527-5335 Suzanne L. Varady

Curriculum free, must pay postage.

A collection of lessons generated by teachers and taken from existing curricula. Divided into five units: What's in the Can, Man?, How Can We Stop Throwing Away So Much "Trash?," Once is Not Enough; Composting, and Landfills and Incinerators. 166 pages, 1990.

Grades 9-12.



Report Card	
General Content	B-
Presentation	C
Pedagogy	C+
Teacher Usability	B+
Solid Waste	B

Comments

General Content

Good as supplementary lessons, but not strong enough to stand alone as a unit. Some activities lack depth.

Presentation

Good charts, graphs, information, and data sheets. Not challenging enough for secondary, would be better in grades 7-9 or for LEP (Limited English Proficient) students. Short on ethics and values.

Pedagogy

Adaptable to a variety of learning modes.

Teacher Usability

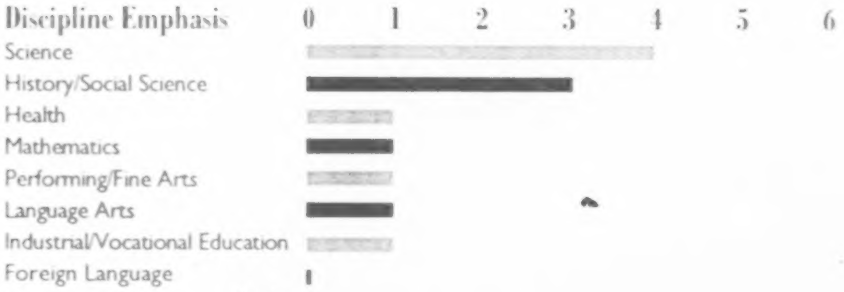
This curriculum is concise and well-organized, with major concepts and goals clearly stated. Background information is unorganized and insufficient for students. The resource list includes a glossary, fact sheets, and lists of agencies.

Solid Waste

Doesn't encourage buying recycled products. Good section on composting. Excellent role playing activity and background information for students on landfills and incinerators. Statistics need updating.

Additional Teacher Thoughts

States initially its own limitations and requests teacher input in terms of additional activities.



UNIT 4
COMPOSTING: LESSON 2
COMPOST--THE END AND THE BEGINNING

LESSON AT A GLANCE

- Recycling by composting improves soil structure and fertility and reduces the volume of household solid waste.

KEY CONCEPTS

Composting reduces household solid waste while returning nutrients to the ground.

OBJECTIVES

Students will learn the basic principles necessary to construct a good compost pile. Students will understand how composting reduces household waste.

TIME

Time will vary--lesson can continue through out the school year.

SUBJECT AREAS

Biology, Horticulture, Vocational Agriculture

VOCABULARY

composting

MATERIALS

Organic waste (manure)
Soil
5-five gallon buckets
Thermometer

ADVANCED PREPARATION

Secure all materials.

TEACHER BACKGROUND

Refer to reproduction of brochures in Unit Background.

TEACHING SUGGESTIONS

1. Read about composting and the alternatives for construction of compost bins or containers. Provide a list of books that are available in your library.

2. Using grass clippings, manure, weeds, hay, sawdust, coffee wastes, etc., start five small experimental compost piles. Make sure not to include bones, meat, grease or other materials that may attract rodents and pests. Try to keep compost piles about one cubic yard, or if necessary, use five 5-gallon buckets with holes drilled in the sides.

3. Each compost pile will be unique in one of the following ways:

   The five experimental conditions:

   a. Low in nitrogen
      - no manure or garbage that is high in nitrogen.
      - moisten, don't soak.
      - turn over regularly, every 3-4 days at first, then once a week.
      - include a mixture of ingredients: garbage, clippings, leaves, weeds, etc.

   b. Not enough moisture
      - include manure and contents which are high in nitrogen.
      - turn regularly.
      - have a good mixture of ingredients.
      - don't water at all and make an effort not to add garbage that has a lot of moisture in it.

Teaching Toxics

Teaching Toxics
Creating Solutions to
Household Pollution

The Association of Vermont Recyclers
P.O. Box 1244
Montpelier, VT 05601
(802) 229-1833 Ivy Zeller

$25.

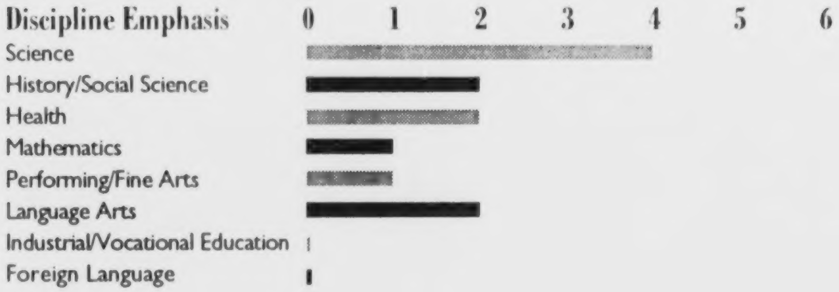
A collection of activities which enable students to become aware of the environmental and health impacts of household hazardous wastes. Consists of four grade-level activity sections (K-3, 4-6, 7-8, 9-12), an information section and a resource section. 104 pages, 1992.

Grades K-12.

Report Card

General Content	B-
Presentation	C+
Pedagogy	C-
Teacher Usability	B
Hazardous Waste	B-

Discipline Emphasis



Comments

General Content

This concise unit fits into many disciplines, but sometimes the lessons are so interdisciplinary they de-emphasize hazardous waste. Makes use of clear science concepts. Sometimes lacks depth, missing important information.

Presentation

The information is presented in a concise, attractive way; well written and illustrated. Information sheets and suggested activities are very complete but they need specific student worksheets to accompany them. There is very little in the way of ready handouts or transparencies. Printed on both sides of recycled-content paper.

Pedagogy

Some low level, "busywork" activities.

Teacher Usability

The information section is very good; student activities should be based on this. Well-organized, easy-to-read, and uncluttered, with a very complete resource listing.

Hazardous Waste

This is a good, concise primer for hazardous waste in the home, especially useful in health and biology classes. Does not cover industrial or business wastes.

Additional Teacher Thoughts

Contains some thought-provoking activities and would be a good addition to an established, comprehensive curriculum.

9 - 12: *Silent Spring* – A Book That Awakened a Nation

Subjects
English, Science, Social Studies

Skills
Analyzing, reading comprehension

Materials
Copies of *Silent Spring*, by Rachel Carson

Time
Assign this book at the beginning of the unit to be read over the course of this study. Students should complete a journal entry for each chapter. Have periodic discussions about the book throughout the unit.

Related AVR Guide Activities
4 - 6 The Tomato Horn Worm Blues

Concept
Silent Spring illustrates ecological principles central to responsible environmental decision making.

Objective
Students will examine how U.S. society became aware of pesticides' environmental impact by reading *Silent Spring*.

Background
See Information Section, pages 87-89. In the early 1960's environmental issues were not as talked about as they are today. The belief of the time was that America's superior technology would solve all of society's problems. Rachel Carson, scientist and author, challenged that assumption in her book, *Silent Spring*, published in 1962. Her meticulous research on the chemical industry's indiscriminate use of pesticides opened America's eyes. Industry and government disputed her conclusions, but scientists worldwide came to her defense. Her work caused the government to reverse its pesticide policy. Through *Silent Spring*, Americans were introduced to ecology — the study of the web of interrelationships to which all living things belong.

Activities
Examining *Silent Spring*

- Assign the reading of *Silent Spring*. Have students keep a journal, and record their reactions, feelings and questions at the end of each chapter.

- Divide the class into groups, and assign each group a chapter to prepare for leading a class discussion. You may want to model how to lead a class discussion. For their discussion, student groups should determine the major points of the chapter, and discuss how the information in the chapter relates to their lives. They should also consider the links between the use of DDT and the improper disposal of hazardous waste.

Points to Ponder

- Issues for the entire class to discuss:
  - — What emotions did you feel while reading the book?
  - — This book was published in 1962. How have things changed? How have they remained the same?
  - — What were the larger ecological principles that were overlooked when DDT was used as a pesticide?
  - — Why do you think *Silent Spring* was effective?
  - — What techniques did Rachel Carson use to appeal to a cross section of people?
  - — What motivates people?
  - — What points to you disagree with? Why?

- Alternative presentation: Read those chapters that are pertinent to specific subjects. For example, human health concerns are addressed in the chapters, "The Human Price," "Through a Narrow Window," and "One in Every Four."

Suggestions for Team Teaching Situation:

- *Creative Writing*: Ask students to write a story that describes the journey of a DDT molecule through the food chain.

- *Social Studies*: Have students explore the chemical industry's reaction to Rachel Carson's *Silent Spring*. Research how DDT was banned from use in the U.S. Where is it still being used today? Is it still legal to manufacture and export DDT from the U.S.?

- *Science*: Explore the types and the extent of scientific inquiry that proved Rachel Carson's thesis. Examine the characteristics of DDT. Why is it so persistent? What other chemicals are persistent in the environment?

Extensions

- *Silent Spring* was successful because it was able to reach a broad base of people. Have students develop a criteria for effective written communication, using Rachel Carson's writing techniques.

- *Silent Spring* is a good example of how one person's actions can change national policy. Research how Lois Gibbs, community organizer of the Love Canal citizens' group and founder of Citizens' Clearinghouse for Hazardous Waste, has affected national policy (Citizens' Clearinghouse for Hazardous Waste, P.O. Box 926, Arlington, VA 99916).

Overview

Environmental Education Curriculum and Compendium Overview

During the last twenty years, a vast amount of environmental education materials have been developed in the United States for the K-12 classroom. Produced by an extensive variety of individuals, agencies, and institutions, these curricula are of varying quality and value to the classroom teacher. It is, at best, a demanding, complex, and challenging process for teachers to select and implement suitable curricula. To facilitate and encourage implementation of high quality curricula, The Science and Environmental Education Unit within the California Department of Education (CDE) established the Curricula and Compendia Project. A project advisory group, made up of representatives from a number of state agencies and offices, delineated the following tasks: (1) collect curricula through a nation-wide search; (2) evaluate the quality of each curriculum using an appropriate assessment instrument; (3) publish evaluation results in topic-specific compendia that use a descriptive, ranked format; and (4) develop and carry out strategies for distribution of the compendia to educators across California.

To make this curriculum review manageable, seven topic areas were logically delineated: Energy Resources, Water Resources, Integrated Waste Management, Air Quality, Plant and Animal Communities, Terrestrial and Aquatic Habitats, and Human Communities. The Energy Resources and Water Resources compendia were published in 1992. These publications were completed through proactive efforts in environmental education by the California Energy Extension Service (Governor's Office) and the California Department of Water Resources (Resources Agency). Both had published their own compilations of curricular materials in the 1980s, which served as Project prototypes.

The evaluation phase of the Curricula and Compendia Project utilizes four strategies: (1) development of the "Unifying Concepts of Environmental Education" matrix by the CDE to serve as a cornerstone linking the project's seven topics; (2) formation of an advisory group of experts for each project to create a topical "Conceptual Matrix" aligned with the unifying concepts; (3) elaboration of topic-specific curriculum evaluation questions that are directly correlated to the "Conceptual matrix"; and (4) systematic evaluation and ranking of environmental education curricula. When completed, the conceptual matrices for the seven compendia will provide an extensive, yet cohesive foundation upon which curriculum writers, environmental educators, and school administrators can base further developments in environmental education.

Conceptual Matrices for Environmental Education

Both the "Unifying Concepts of Environmental Education" and the "Conceptual Matrix for Integrated Waste Management Education," illustrated on the following pages, are based upon the environmental education philosophy of the California Department of Education, described in the "Point of View on Environmental Education" (1990). The "Unifying Concepts of Environmental Education" serve to provide a conceptual foundation for defining the boundaries of all environmental education. On the "X" axis are found three content descriptors: "The Natural Environment," "The Built Environment," and "The Personal Environment." On the "Y" axis are three process skills that encompass the full range of cognitive and affective change: awareness, understanding, and action.

In the conceptual matrix for this compendium, the nine identified core concepts define the essence of integrated waste management curricula.

Because environmental education is an interdisciplinary subject, the basic concepts of integrated waste management correspond, to some degree, to all of the frameworks for California public schools. The science and history/social science frameworks are particularly relevant. This correlation has been substantially referenced on page 96.

Unifying Concepts of Environmental Education

Content Process	**The Natural Environment:** Natural Systems and Interactions	**The Built Environment:** Human Alterations to Natural Systems	**The Personal Environment** Citizens' Roles, Responsibilities, Choices, and Actions
Fostering Awarness of and Respect for the Environment	Environmentally aware citizens cultivate in themselves and others a deep appreciation for natural systems and personal interactions with the natural environment. *California Curriculum Framework References: Science: Living Things, Ecosystems, Oceanography*	The individual members of sustainable human communities value the natural environment and recognize humankind's ultimate dependence on renewable and non-renewable resources. *History and Social Science: Geographic Literacy; Science: Geology and Natural Resources, Living Things, Ecosystems*	An individual's quality of life and attitude toward the environment depend on the distribution and quality of natural resources, which may be regulated by laws and influenced by local interests, cultural values, political climate, and international relations. *History and Social Science: Sociopolitical Literacy, Cultural Literacy, Constitutional Heritage, National Identity*
Understanding Basic Environmental Concepts	The ultimate source of energy is the sun, and its energy is transformed and lost as it flows through ecosystems, of which human beings are a part. *Science: Living Things, Energy, Ecosystems, Matter*	Human communities alter the natural and built environments through development and, as human populations increase, their impacts on the global environment become more pronounced. *History and Social Science: Historical Literacy, Geographic Literacy; Science: Geology and Natural Resources, Science, Technology and Society*	Every human affects the environment and can influence change through individual and collective action, civic responsiveness, consumer preference, and career choice. *History and Social Science: Civic Values, Rights, and Responsibilities, Sociopolitical Literacy, Participation Skills*
Sustaining Resposible Actions Toward the Environment	To sustain the integrity of natural systems, humans must minimize their effects on the environment by thoughtfully restoring and preserving habitats' and species' diversity and protecting the quality of all natural resources. *History and Social Science: Historical Literacy, Ethical Literacy; Science: Ecosystems, Geology and Natural Resources*	The individual members of sustainable human communities learn from past experiences, acknowledge human limitations, anticipate changes, and develop innovative systems to conserve resources vital to both the natural and built environments. *History and Social Science: Ethical Literacy, Critical Thinking Skills, Historical Literacy, Economic Literacy; Science: Geology and Natural Resources, Science, Technology and Society*	Citizens of sustainable human societies manage natural and built systems responsibly and, with current understanding, capability, and foresight, regulate the careful use of natural resources by analyzing the benefits, costs, tradeoffs, and long-term effects of each alternative. *History and Social Science: Civic Values, Rights and Responsibilities, Economic Literacy, Critical Thinking Skills, Participation Skills; Science: Science, Technology and Society*

Conceptual Matrix for Integrated Waste Management Education

Content Process	**The Natural Environment:** Natural Systems and Interactions	**The Built Environment:** Human Alterations to Natural Systems	**The Personal Environment** Citizens' Roles, Responsibilities, Choices, and Actions
Fostering Awarness of and Respect for the Environment	All living things create waste. In unaltered systems, there are balances between the production and breakdown of waste.	Humans alter natural systems through the extraction and processing of resources, and through the incineration and/or disposal of waste produced.	Responsible individuals recognize their attitudes and actions regarding resource use and waste generation have an impact on the environment.
Understanding Basic Environmental Concepts	Waste is a by-product of life. In natural systems, waste is broken down by chemical and physical means, and can be used by other living things.	Impacts of the volume and toxicity of human-created waste increase as human population and resource consumption rise.	People, through their expectations, lifestyle choices, and personal use of resources and products, create varying amounts of waste, some of which may be hazardous.
Sustaining Resposible Actions Toward the Environment	Natural systems exhibit a limited capacity to process human created waste. Through appropriate human action, waste production and toxicity are reduced.	Sustainable human communities develop ecologically sound methods for managing resource use, waste generation, and disposal and incineration.	Responsible individuals analyze the long term effects, costs, benefits, and trade-offs of their lifestyle choices in order to keep waste to a minimum, and responsibly and safely manage the waste they generate.

Conceptual Matrix Framework Correlations

Content Process	**The Natural Environment:** Natural Systems and Interactions	**The Built Environment:** Human Alterations to Natural Systems	**The Personal Environment** Citizens' Roles, Responsibilities, Choices, and Actions
Fostering Awarness of and Respect for the Environment	Science: Life Sciences, Physical Sciences, Earth Sciences. History/Social Science: Knowledge and Cultural Understanding. English/Language Arts: The Art of Questioning, Direct Teaching of Learning Strategies. Mathematics: Mathematical Ideas, Mathematical Thinking, Tools and Techniques, Communication. Visual and Performing Arts: Aesthetic Perception, Creative Expression, Aesthetic Valuing.	Science: Life Sciences, Physical Sciences, Earth Sciences. History/Social Science: Knowledge and Cultural Understanding, Democratic Understanding and Civic Values, Skills Attainment and Social Participation. English/Language Arts: The Art of Questioning, Direct Teaching of Learning Strategies. Mathematics: Mathematical Ideas, Mathematical Thinking, Tools and Techniques, Communication. Visual and Performing Arts: Aesthetic Perception, Creative Expression, Aesthetic Valuing.	Science: Life Sciences, Physical Sciences, Earth Sciences. History/Social Science: Knowledge and Cultural Understanding, Democratic Understanding and Civic Values, Skills Attainment and Social Participation. English/Language Arts: The Art of Questioning, Direct Teaching of Learning Strategies. Mathematics: Mathematical Ideas, Mathematical Thinking, Tools and Techniques, Communication. Physical Education: Self-image and Self-realization, Individual Excellence. Visual and Performing Arts: Aesthetic Perception, Creative Expression, Arts Heritage, Aesthetic Valuing.
Understanding Basic Environmental Concepts	Science: Life Sciences, Physical Sciences, Earth Sciences. History/Social Science: Knowledge and Cultural Understanding. English/Language Arts: The Art of Questioning, Direct Teaching of Learning Strategies. Mathematics: Mathematical Ideas, Mathematical Thinking, Tools and Techniques, Communication. Visual and Performing Arts: Aesthetic Perception, Creative Expression, Aesthetic Valuing.	Science: Life Sciences, Physical Sciences, Earth Sciences. History/Social Science: Knowledge and Cultural Understanding, Democratic Understanding and Civic Values, Skills Attainment and Social Participation. English/Language Arts: The Art of Questioning, Direct Teaching of Learning Strategies. Mathematics: Mathematical Ideas, Mathematical Thinking, Tools and Techniques, Communication. Visual and Performing Arts: Aesthetic Perception, Creative Expression, Aesthetic Valuing.	Science: Life Sciences, Physical Sciences, Earth Sciences. History/Social Science: Knowledge and Cultural Understanding, Democratic Understanding and Civic Values, Skills Attainment and Social Participation. English/Language Arts: The Art of Questioning, Direct Teaching of Learning Strategies. Mathematics: Mathematical Ideas, Mathematical Thinking, Tools and Techniques, Communication. Physical Education: Self-image and Self-realization, Individual Excellence. Visual and Performing Arts: Aesthetic Perception, Creative Expression, Arts Heritage, Aesthetic Valuing.
Sustaining Resposible Actions Toward the Environment	Science: Life Sciences, Physical Sciences, Earth Sciences. History/Social Science: Knowledge and Cultural Understanding, Democratic Understanding and Civic Values, Skills Attainment and Social Participation. English/Language Arts: The Art of Questioning, Direct Teaching of Learning Strategies. Mathematics: Mathematical Ideas, Mathematical Thinking, Tools and Techniques, Communication. Visual and Performing Arts: Aesthetic Perception, Creative Expression, Aesthetic Valuing.	Science: Life Sciences, Physical Sciences, Earth Sciences. History/Social Science: Knowledge and Cultural Understanding, Democratic Understanding and Civic Values, Skills Attainment and Social Participation. English/Language Arts: The Art of Questioning, Direct Teaching of Learning Strategies. Mathematics: Mathematical Ideas, Mathematical Thinking, Tools and Techniques, Communication. Physical Education: Social Development and Interaction. Visual and Performing Arts: Aesthetic Perception, Creative Expression, Aesthetic Valuing.	Science: Life Sciences, Physical Sciences, Earth Sciences. History/Social Science: Knowledge and Cultural Understanding, Democratic Understanding and Civic Values, Skills Attainment and Social Participation. English/Language Arts: The Art of Questioning, Direct Teaching of Learning Strategies. Mathematics: Mathematical Ideas, Mathematical Thinking, Tools and Techniques, Communication. Physical Education: Social Development and Interaction, Self-image and Self-realization, Individual Excellence. Visual and Performing Arts: Aesthetic Perception, Creative Expression, Arts Heritage, Aesthetic Valuing.

Waste Management Evaluation Tool

The following environmental education evaluation instrument was used by the project's environmental educators to evaluate the hazardous and solid waste management curricula. This instrument reflects the recommendations and perspectives of the following documents:

- "1992 Science Instructional Materials Evaluation Form," California Department of Education, 1992.
- History-Social Science Framework for California Public Schools (pp. 114-120), California Department of Education, 1988.
- Science Framework for California Public Schools (Chapter 8, pp. 198-213), California Department of Education, 1990.
- Science Resource Center, "Rating System for ME-2," Los Angeles Unified School District.
- "The Superintendent's Point of View on Environmental Education," California Department of Education, 1990.
- UNESCO, "The Belgrade Charter," UNESCO-UNEP Environmental Education Newsletter, Volume 1, Number 1, January, 1976.

I. Criteria for Instructional Materials

A. General Content

1. Are ideas expressed through unifying themes and big ideas, not facts?

2. Is content interdisciplinary?

3. Are students challenged to utilize higher level thinking processes (i.e., inferring, relating, and applying)?

4. Are ideas presented logically and connected through the curriculum?

5. Is depth of understanding emphasized (rather than encyclopedic breadth)?

6. Are historical, ethical, cultural, geographic, economic, and sociopolitical relationships addressed?

7. Are knowledge and learning shown as connected to students' lives and society?

B. Presentation

1. Are instructional materials clearly and engagingly written with the main concepts well articulated?

2. Are the roles of environmental ethics, citizenship, and stewardship explored?

3. Do lessons promote respect and caring for the environment, yet are nondogmatic and open to inquiry and differences of opinion?

4. Are personal and societal values and conflicting points of view explored in context?

5. Are instructional materials easy for students to use and understand?

6. Is learning made accessible to LEP students?

7. Are writing and concepts developmentally appropriate for the designated grade, yet sensitive to individual differences in educational experience and learning mode?

8. Is environmental responsibility modeled in design, underlying philosophy, and suggested activities by the lessons and materials (e.g., using recycled materials and properly disposing of wastes)?

9. Are there clear linkages presented between communities of all levels ("thinking globally, acting locally")?

10. Are vocabulary words defined in context and not dominating of learning goals?

11. Is the layout of instructional materials interesting and appealing?

C. Pedagogy

1. Does almost half the curriculum have students engaged in active learning?

2. Is learning based on students constructing knowledge through research, discussion, and application to gain conceptual understanding?

3. Are evaluation devices included and appropriate? (Highest points for authentic, performance based assessment devices.)

4. Are instructional materials sensitive to social, economic, and cultural diversity?

5. Do lessons encourage students to develop awareness, knowledge, and strategies for responsible action?

6. Are group/cooperative learning strategies used?

7. Is intergenerational responsibility, linking today's actions with future consequences, implicit in instruction?

D. Presentation

1. Are instructions for the teacher clear and concise?

2. Are lesson objectives/outcomes clear and appropriate?

3. Are materials easily integrated into an established curriculum?

4. Is background information for the teacher adequate and accurate?

5. Can the materials be adapted to varied learning environments (large/small classes, of mixed levels, from rural/urban settings)?

6. Are consumable instructional materials of good quality, easily duplicated for student use, and in sufficient quantity to support the objectives?

7. Are equipment/materials listed and reasonably accessible?

8. Are a variety of instructional strategies, expanded learning environments, and resources suggested in the curriculum's design?

9. Is the time required to complete each lesson indicated?

10. Do the materials clearly list the subject discipline(s) integrated into each lesson?

E. Hazardous Waste Content

1. Do the materials define the characteristics of hazardous waste/substances (ignitability, corrosivity, reactivity, toxicity)?

2. Do the materials explain the three routes of exposure to hazardous substances (inhalation, absorption, ingestion)?

3. Do the materials emphasize precautions that must be taken when using hazardous substances at home, at work, or in school?

4. Do the materials provide information on less hazardous alternatives for household toxics, and on their advantages and disadvantages?

5. Are students taught the importance of their roles as consumers and as educators of family and friends regarding hazardous substances?

6. Do the materials explain the different methods of disposal for household and/or industrial hazardous waste (sink, trashcan, storm drain, incinerator, landfill, etc.), and the importance of choosing the correct method for each type of waste?

7. Are students taught how improper disposal by industry or individuals (through intent or negligence) can contaminate water, soil, and air, thereby affecting all living things?

8. Do the materials discuss the different types of businesses that create hazardous materials and/or waste, and that such waste can be generated in the production of beneficial goods and services?

9. Do the materials discuss the long-term effects of hazardous materials/waste on the environment and living things; specifically the

concepts of persistence, bioaccumulation, and the problems of abandoned waste sites?

10. Do the materials emphasize the importance of reducing the volume and toxicity of hazardous substances and waste by individuals, businesses, and industry?

F. Solid Waste Content

1. Do the materials promote the waste management hierarchy beginning with waste reduction, followed by recycling and composting, ending with landfilling or incineration?

2. Do the materials discuss all steps in the recycling process (including collection, remanufacture, and purchase of recycled products)?

3. Do the materials discuss the potential environmental impacts of landfills (groundwater contamination, landfill gas, closure and monitoring, etc.)?

4. Do the materials connect resource use with waste production (waste as a result of unwise or excessive use of resources)?

5. Do the materials discuss different source reduction strategies that can be used by individuals, business, and industry?

6. Do the materials discuss the benefits of using recycled, rather than virgin materials (such as energy savings, reduced dependence on natural resources, and reduced pollution)?

7. Do the materials discuss alternatives to landfilling of solid waste (waste prevention, recycling, composting, incineration)?

8. Do the materials address siting issues (environmental impacts, permitting, NIMBY, etc.) associated with solid waste facilities (landfills, incinerators, composting operations, and other sites)?

9. Are students taught their roles as consumers and as educators of family and friends regarding solid waste generation?

10. Are students taught about various forms of composting and its potential to reduce the volume of organic material in the waste stream?

II. Narrative/Miscellaneous

A. Briefly comment on the strengths of the curriculum.

B. Briefly comment on the weaknesses of the curriculum.

C. Other comments

D. If it focused on a specific geopolitical area not including California, can it be easily adapted to the needs of California classroom teachers?

E. Are materials available in more than one language? If so, what part of the curriculum and which languages?

F. Do the materials contain a listing of resources, such as an appendix or teacher resource guide?

G. In the table below, place a checkmark in the appropriate box next to each discipline to estimate the amount of emphasis each is given in the curriculum.

	None	Some	A lot	Major Emphasis
Science	☐	☐	☐	☐
History/Social Science	☐	☐	☐	☐
Health	☐	☐	☐	☐
Mathematics	☐	☐	☐	☐
Fine/Performing Arts	☐	☐	☐	☐
Language Arts	☐	☐	☐	☐
Industrial Tech/Voc. Ed	☐	☐	☐	☐
Foreign Language	☐	☐	☐	☐

Other Waste Management Curricula Evaluated

The following materials were evaluated by the teacher teams, but not chosen for inclusion in the compendium. These items may be useful tools for teaching about waste management, but did not meet the evaluation guidelines in some way at the indicated grade levels.

Activities for Teaching About Hazardous Materials in the Home (K-12), ERIC: Clearinghouse for Science, Mathematics, and Environmental Education, The Ohio State University, Columbus, OH.

A Way with Waste (K-3), Washington State Department of Ecology, Bellevue, WA.

Community Cats: Solid and Hazardous Waste Education Program (grade 3), Minnesota Office of Waste Management, St. Paul, MN.

The Environment and the Community (10-12), Resource Center for EOHSI, Public Education and Risk Communication Division, Piscataway, NJ.

Environmental Education Program: Hazardous Waste Curriculum (7-9), Missouri Department of Natural Resources, Jefferson City, MO.

4th R Recycling Curriculum (K-5), San Francisco Recycling Program, San Francisco, CA.

Florida 4Rs Project (K-3, 6-8), Florida Department of Education, Tallahassee, FL.

Hazardous Waste Educational Resource Kit (9-12), The Federation of Ontario Naturalists, Toronto, Canada.

Hazardous Waste from Homes (9-12), Enterprise for Education, Santa Monica, CA.

Household Hazardous Materials: Pollution Solutions Start at Home (6-9), Household Hazardous Materials Program, San Diego County, CA.

Household Hazardous Waste: How it Fits Into Your Curriculum (10-12), Town of Yorktown, NY.

K-5th Grade Curriculum Lesson Helper (K-5), Department of Recreation, Parks, and Community Services, San Jose, CA.

The Land We Depend On (grade 5), Illinois Environmental Protection Agency, Springfield, IL.

Let's Reduce and Recycle: Curriculum for Solid Waste Awareness (K-12), U.S. Environmental Protection Agency, Washington, D.C.

The No Waste Anthology (K-3), California Department of Toxic Substances Control, Sacramento, CA.

Operation Separation (K-6, 7-12), Onandaga County Resource Recovery Agency, North Syracuse, NY.

Pennsylvania Recycling and Waste Reduction Curriculum Activities (K-6, 7-12), Pennsylvania Department of Education, Harrisburg, PA.

Project Erase Waste (grade 6), Kern County Public Works, Bakersfield, CA.

Recycle Hawaii for Kids (K-3, 4-6), City and County of Honolulu, Division of Refuse Collection and Disposal, Honolulu, HI.

Recycle Team (3-4), 3R Services/Southwest Regional Laboratory, Santa Rosa, CA.

Recycling: A Solution to Pollution (K-4), Community Recycling Center, Champaign, IL.

Reduce, Re-use, Recycle Alaska (4-6), Alaska Department of Environmental Conservation, Pollution Prevention Program, Juneau, AK.

SLEUTH: Strategies and Lessons to Eliminate Unused Toxicants. Help! (4-12), Household Hazardous Waste Disposal Project/Water Resources Section, Seattle, WA.

Solid Waste Activity Packet for Teachers (7-9), Illinois Department of Energy and Natural Resources, Springfield, IL.

Other Curricula Evaluated (Cont.)

Southern Humboldt Recycling Education Pilot Project (K-6), Southern Humboldt Recycling Program Coordinator, CA.

Supplementary Science Kit (4-6), Alaska Department of Environmental Conservation, Pollution Prevention Program, Juneau, AK.

Teacher's Resource Guide for Solid Waste and Recycling Education (K-3, 9-12), Association of Vermont Recyclers, Montpelier, VT.

Teaching About Hazardous and Toxic Materials (K-12), ERIC Clearinghouse for Science, Mathematics, and Environmental Education, The Ohio State University, Columbus, OH.

Teaching Toxics: Creating Solutions to Household Pollution (K-3), Association of Vermont Recyclers, Montpelier, VT.

Think Earth! Environmental Education Program (K-3), Education Development Specialists, Lakewood, CA.

Think Twice Before You Toss (K-3, 4-6, 7-9), Minnesota Office of Waste Management/Kandiyohi County Household Hazardous Waste Program, St. Paul, MN.

Toxic Waste: A Teaching Simulation (7-9), SEPUP, Lawrence Hall of Science, Berkeley, CA.

Toxics in My Home? You Bet! (K-3, 7-8, 9-12), Golden Empire Health Planning Center/Local Government Commission, Sacramento, CA.

Trash Today, Treasure Tomorrow (K-3), University of New Hampshire Cooperative Extension Program/Governor's Recycling Program, Concord, NH.

Waste: A Hidden Resource (10-12), Tennessee Valley Authority/Keep America Beautiful, Inc., Stamford, CT.

Waste in Place: Elementary Curriculum Guide (K-6), Keep America Beautiful, Stamford, CT.

Waste Management: Awareness, Attitudes, Activities (K-12), St. Lawrence County Solid Waste Disposal Authority, NY.

Where is Away When You Throw it Away? (4-6), Richmond Sanitary Service, Richmond, CA.